FOUNDRY TRADE JOURNAL
Established 1902
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 87 Thursday, July 7, 1949 No. 1714

49, Wellington Street, London, W.C.2

'Grams : " Zacatecas, Rand, London "

'Phone : Temple Bar 3951 (Private Branch Exchange)

PUBLISHED WEEKLY : 26s. per annum (Home and Overseas)

Stability Through Dynamics

In connection with the Jubilee Celebrations of the Metropolitan-Vickers Electrical Company, Limited, visitors from all over the country are being shown the modernised foundry department. We were invited to join members of the Lancashire Branch of the Institute of British Foundrymen, who were included amongst the invited. One of the objects of such visits is the acquisition of technique and, what is more important, lessons may be learnt from general management and policy. Now, the Trafford Park plant is not the first to be thoroughly modernised, nor will it be the last; yet if such *démarchés* are considered to be the end of a plan, then the spirit behind the enterprise is faulty. In the case of the Metropolitan-Vickers foundry reorganisation, Mr. W. Symes, director and works manager, made the situation quite clear in the course of a short address to the visitors. His views were that too many foundries had done too little in the way of modernisation between the wars; the heavy task his firm had already accomplished represented about one-third of what was envisaged and, when this was finished, it was the intention of the management to start all over again. By way of example, he quoted the painting of the foundry, for herein is an outstanding example of the intelligent and pleasing use of colour in industry. This work is treated exactly like the Forth Bridge, that is, as soon as one end of the shops is reached, the painters restart at the beginning.

Herein, then, is a worthwhile lesson; the modernisation of a foundry is a dynamic operation and not static. Only too often we have seen the carrying through of a major reconstruction of a foundry to the complete satisfaction of the management and then inertia has set in and continued until, quite suddenly, there is a realisation that the shops are as old-fashioned as a Victorian parlour. A prime requisite to a dynamic conception of a foundry installation is initial elasticity in layout, and all plant should be examined from this angle. For instance, current production may not require any coring facilities, yet thought should be given to the subject in case a major change comes along.

The tidiness and cleanliness of this foundry were alike remarkable, and were an object lesson for all to learn and put into operation in their own plants. We travelled down to Manchester by train and, on arrival, the water after washing was of a much darker hue than that used after an afternoon spent in the foundry. Thus, a high standard of atmospheric cleanliness has been attained and there is every assurance that it will be maintained. For the successful conduct of a foundry, stability is obviously a dominant factor; yet stability must not be confounded with static conditions. Stability can be assured by the recognition that a foundry is nowadays a dynamic enterprise. A foundry which a quarter of a century ago was deemed to be a real "show-place" would to-day be considered obsolete. The picture is not difficult to draw. The walls would be whitewashed, whilst all else would be black. There would be moulding machines, but the whole of their servicing would be manual. The moulds would be knocked out *in situ* and the transport of sand would be by barrows. The efficiency of the ventilation, heating and lighting would be largely a matter of chance. To-day's "show" foundries will appear just as backward by the time another quarter of a century has elapsed, unless this striving after the dynamic is adopted as a basic principle of management.

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Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

COSTING IN IRONFOUNDRIES

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—Mr. D. J. Close's Paper published in your issues of May 5 and 12 is said to raise many controversies. But is this not because things, which are really very simple, are caused by people with "balance-sheet" minds to appear extraordinarily obscure? As an example of the simple—a cupola was charged with 100 tons of a mixture of pig-iron, scrap steel and scrap iron. This, when melted, was tapped into ladles and thence into pig-beds. We obtained 91 tons of pigs. Therefore, it required no accountant to tell us that nine per cent. of our metal, cupola labour, power, fuel, flux and ganister had vanished and that someone had to foot the bill. Naturally, we lumped the loss on to the cost of the pig-iron. Every foundryman knows that, no matter whether he is making good castings, waster castings, pig-iron, or heads, runners, risers, or scrap iron, nine per cent. loss is the same on each and must be paid for if the foundry is not to go "broke."

Some people argue that, if they *sell* their home scrap, its value is what they get for it. But if they get for it less than it cost them to manufacture, they have made a loss and, if their books do not charge it to their castings, then it is coming out of the foundry's own pocket and rendering the concern financially unstable. It matters not whether it be sold, used, thrown away or put in the bottom drawer, it cost so much to make and that is its book value to the foundry which made it.

A simple factor such as nine per cent. loss on metal charged and on the cost of melting would do away with a lot of weighing and recording which, when all is said and done, is probably unreliable save in the very best ironfoundries in Utopia.—Yours, etc.,

HORACE J. YOUNG.

15, Lansdowne House,
Manchester, 20.

THE IRON & STEEL BILL

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—It is not surprising there should be editorial support in your journal for the iron and steel interests in their campaign against nationalisation, but in assessing the desires of the operatives in this connection you show remarkably little knowledge.

In questioning the competency of my own union, the Amalgamated Union of Foundry Workers, to judge the issue from inside knowledge of the interior of iron and steel works, you give an evaluation to editorial opinion no different from that given my union in your editorial.

I, of course, disagree with your evaluation, and would have thought the iron or steel founder had a very special interest in the source of raw material. You can be assured that the foundry worker does have such an interest, and he is by no means so much alone as you suggest. It is true that my own union was particularly vigorous in support of nationalisation, and gave the matter much greater urgency than did some other interested trade unions. However, I have yet to learn that those other unions were not forthright in support of nationalisation, and I rather think the members of those unions will be surprised that you should find it so difficult to assess their desires with regard to the future of their industry. Indeed, the unions concerned were, and are, much more forthright in support of the Government Bill than is my own union.

The foundryman would have been more satisfied had the Bill to nationalise iron and steel included more foundries and had it been less generous to the owners, who have already taken more out of the industry than ever they put in. It is quite unlikely you will agree with that point of view, but it is none the less valid as the point of view of the Amalgamated Union of Foundry Workers.—Yours, etc.,

J. GARDNER.
(*General Secretary*).

Amalgamated Union of Foundry Workers,
164, Chorlton Road, Brooks's Bar,
Manchester, 16.
July 4, 1949.

More Foundry Amenities

Matthew Swain, Limited, Newton Heath, well-known ironfounders, have completed a further stage in their long-term policy of improvements for the benefit of the employees. As a family concern, this company, which has been established since 1876, has always shown the deepest interest in personnel welfare. Some time ago a first-class canteen was provided, and now washing facilities for the workers have been completed. The new premises have been installed with the most modern equipment in the way of washing fountains, showers and cloakroom equipment. Dressing cubicles have been provided, and there are also clothes-drying facilities. The walls are fully tiled, and chromium-plated fittings have been used.

Latest Foundry Statistics

The Bulletin of the British Federation of Iron and Steel Manufacturers for May shows that there were 1,107 fewer employees engaged in the ironfounding industry on April 9 as compared with March 5. Since that date there has been a further decline. On April 30 the total employment was 148,198, as against 148,766 on April 9. Included in the monthly loss were 313 female employees.

During April, the weekly average of the weight of liquid steel put into steel castings declined from 1,470 to 1,430 tons, and average weekly deliveries decreased from 3,900 to 3,400 tons as compared with March. Employment in this section of the industry went down from 19,667 to 19,593 during March.

Training of Apprentices in the French Foundry Industry*

Detailed Schemes for Various Grades

By D. Waeles

Special Aspects of the Foundry

The numerous characteristics which differentiate the foundry from the other metallurgical industries have conferred special aspects upon the problem of trade apprenticeship within the industry. The essential points are dealt with briefly below.

(1) *Training Techniques.* These are as numerous as they are complex. *Moulding and coremaking* may be the most characteristic operations, but assembling of moulds, sand preparation, mould drying, melting and refining of metals and casting are also important phases. A skilled tradesman's training should, therefore, include knowledge of a wide diversity of raw materials, machinery or tools and of processes.

(2) *Physical Conditions of Working.* Without being unhealthy, they are without doubt inferior to the general conditions within the metallurgical industries, by reason of the raw materials used (talc, sand, plumbago, coke, etc.), the high temperatures which attend the stoving and melting operations, together with the fumes which vitiate the atmosphere of the shops. It should be added that a great number of small foundries are too confined and insufficiently ventilated, and possess neither cloakrooms nor shower baths. These poor working conditions weary the staff and it can be stated that a number of young workmen abandon the trade—something of the order of 30 per cent., according to a recent census.

(3) *The Structure of the Trade.* Foundries are spread all over France, with concentrations in the Paris region, the North, the Ardennes, the Lyons district, the East and the large ports. [A map was included with the French text showing their location.] Many concerns, especially those specialising in bronze and light alloys, are still in the "workshop" stage and large-scale manufacturing is practically non-existent in these sections. The following table shows percentage employment according to size of foundry.

Effective total of workmen per foundry.	Percentage of the effective total of the industry.	Percentage of the number of firms in the French foundry industry.
1 to 10 ..	8	45
11 to 50 ..	25	38
51 to 100 ..	16	9
101 to 500 ..	38	7
More than 500 ..	13	1

The overall average is 38 workmen per concern.

(4) *Economic Aspect.* Some important branches of the French foundry industry have their production highly organised, especially in the case of pipe foundries and the makers of builders' and domestic castings. With other specialities, and more particularly with the jobbing foundries, the structural splitting up into small units of the major part of the industry is often influenced by orders. Small or medium runs are the general rule. Investigations as to the best methods to be adopted are often left to the personal initiative of the workman and his skill has to include the manifold problems of moulding and coremaking. Intuition, deduction and experience are factors which assume a special importance in the technical training of the skilled workman.

(5) *Structure of the Labour Force.* In 1947, the total labour force was of the order of 78,000 in the unattached foundries and included approximately:—

Staff	8,700	people or	12	per cent.	of the	total
Skilled workmen ..	18,500	,, ,,	24	,,	,,	,,
Semi-skilled	26,000	,, ,,	36	,,	,,	,,
Labourers	20,800	,, ,,	26	,,	,,	,,
Apprentice moulders ..	3,120	.. ,,	4	,,	,,	,,

Two-thirds of the apprentices are indentured. Because of the steps taken during the last two years by the foundry industry, it is probable that the labour force has been increased by 15 per cent., and the industry should now be able to call upon $18{,}500 \times \frac{115}{100} = 21{,}275$ skilled operatives, plus one-seventh of this figure for "tied" foundries, making about 25,000 qualified artisans. Amongst these, there are (*a*) the moulders and coremakers, making about 80 per cent. of the total and whose training is controlled through the award of a Craftsmen's Diploma of Aptitude; (*b*) metal pattern-makers and modellers, and (*c*) maintenance men. In the two last categories highly-qualified men are sadly lacking in foundry concerns.

The general staff of the works is made up of those on the monthly salary list. They number about 4,000, divided into two main categories: (*a*) operating staff (charge hands and foremen), whose qualifications are covered by the award of a recognised certificate, and (*b*) the management ("*ingénieurs*"* and managers, logically provided by the "*Ecole Supérieure de Fonderies.*"

Because of the pronounced tendency of the industry towards the use of greater quantities of more

*Official Exchange Paper from the Association Technique de Fonderie, presented at the 46th Annual Meeting of the Institute of British Foundrymen at Cheltenham. Translated by V. C. Faulkner.

* Translator's Note.—The title given to students passing the examinations set by the recognised technical colleges.

Training in French Foundries

complicated plant, the part played by the staff becomes more and more the predominant feature.

Fundamental Problems in Training

After considering the essential needs, the training of youth for the French foundry industry involves the close study of the following aspects:—

(1) Special efforts to be made in the field of recruitment and selection.

(2) Need for instruction in every area.

(3) To strengthen and develop the training of a highly qualified labour force, chargehands and foremen.

(4) Provision of means for easy instruction at all stages through the distribution of technical and practical text-books.

Recruitment

One cannot get away from the fact that it is often only by chance that youths are drawn to industry when leaving the various routines of an unspecialised general education to take up a skilled trade. It is obvious that, at all stages of recruitment, it is desirable to draw attention to all the various trades practised and thereby to raise the average level of selections involved.

At the initial stage, which is that of apprenticeship, it is essential for the industry to be understood both by the youths as well as those responsible for them (parents and teachers) and to overcome the usual objections (heat, dust and burns). Many lines of action can be taken, including the following:—

Approach to Youth.

(*a*) Talks, along with demonstrations, in the primary schools.

(*b*) Visits to foundries and institutions.

(*c*) Distribution of propaganda books, such as has been done so effectively by the Swiss foundry owners.

Approach to Parents.

(*a*) The showing in all French cinemas of a foundry documentary film (to be released next September).

(*b*) The publishing of leaflets and brochures which will emphasise the advantages and attractions of the trade.

(*c*) Advertisements in the local Press.

(*d*) Billposting in areas near the foundries.

(*e*) Radio propaganda.

Approach to the Teachers and Managers of the Primary Schools. This may be effected by:—

(*a*) Co-operation between the foundry employers and local educational authorities.

(*b*) Distribution of appropriate literature.

Approach to the "Juvenile Employment Advisory Councils." An Act of Parliament, made law in May, 1938, created "juvenile employment advisory councils" for all adolescents under seventeen years of age, who desire to be employed in an industrial enterprise, but this regulation has only been partially carried out, for only the large centres of population have created offices and engaged staff. The objects of such organisations are: In large centres, all the boys who leave the primary schools have to appear before the "careers" director and submit to a medical examination. Collective and individual tests, in conjunction with the school report, give a good estimate of mental and moral characteristics, whilst the recommendations, together with the report of any physical disabilities, are established by the doctor. [The Paper includes, as Appendix II,† the schedule to be completed in respect of each boy examined. It is divided into two sections—attainments and conduct. The first part is filled in by the physical training instructor, handicraft teacher, and class teacher; the second by a psychiatrist who reports on appearance, reactions, self-confidence and the like.] The individual reports being available, the vocational guidance experts, who are familiar with the specialised needs of the various trades, can give advice with confidence. Thus, youngsters avoid getting jobs for which they are totally unfitted and which consequently jeopardise their future. The French foundry industry is following with close interest this novel development; it has sent to each "Youth Guidance Centre" in France details of their training schemes for moulders and coremakers, and it maintains close co-operation with these bodies. [Appendix III includes a short description of the type of work done by a moulder, the tools he uses, his working conditions, and industrial hazards; desirable physical aptitudes; unsuitable types on health grounds; economic information (an apprentice earns 300,000 to 400,000 francs during his three years' indentures); advantages of the trade; the availability of trade training and prospects. (The brightest boys have the prospect of becoming "*ingénieurs*").]

The Ideal Training for the Apprentice

Much controversy exists as to the best means of training apprentices. A certain number of master-men in the industry have not, so far, taken any interest in the practical training of boys. The large majority of foundry owners have now passed beyond this stage and agree that their apprentices should receive additional instruction of a general character, some technological instruction and some drawing. Further, there are some isolated large foundries both unattached and "tied" who are co-operating and, in conjunction with these, the following precepts have been laid down.

(1) *Trade Training.* Here progressive practical work with its essential discipline is reinforced by an intellectual education, with some technology and drawing. On this basic effort will depend the skill of the workman, his output and his earnings.

(2) *Ancillary to General Training.* Knowledge of the mother tongue is induced by spelling exercises, improvement in mathematical reasoning, by arithmetic and geometry; the increase in general knowledge is effected by the study of history and geography. Apprentices are thus trained to understand the realities of life and their outlook is thereby broadened.

(3) *Physical Training.* Short, daily attendances at well-organised physical culture classes are conducive to good health and muscular development, and, moreover, are helpful in instituting discipline. Youngsters undergoing this training become stronger, more efficient and skilful in the movement necessary to the proper exercise of the craft.

†A complete list of appendices is included at the end of the Paper.

(4) *Moral and Social Training.* To learn a trade is a recognised necessity, but to learn how to live, with a sense of citizenship, to co-operate, to think logically, to deduce facts and act thereon, are virtues or aptitudes of an equally fundamental nature. It is essential to focus the attention of youth on the part they will be called upon to play in a co-operative existence and on their civic duties and craftsmanship obligations.

(5) *Cultural Training.* This training, so far but little developed, is designed to draw the attention of youths to artistic and intellectual pursuits. Through lectures, concerts, visits to museums, by the organisation of small groups interested in music, dancing, drawing, painting, or drama, means will be provided for the student to get away from technology and acquire genuine happiness in fresh leisure-time activities.

The Training of the Various Sections by the French Foundry Labour Force

Labourers. This category of workmen, whose job is sand handling and the like, need not be considered.

Semi-skilled Workmen. Included under this heading are the men engaged on sand preparation, stove-hands, fettlers, machine moulders, mass-production core-makers, cupola-men, melters (furnace attendants) metal-pourers and crane drivers. These men play an important part in successful foundry operation. It is therefore necessary that they be trained and, to this end, two methods have been adopted:—(*a*) The distribution of booklets setting out, for the semi-skilled men, the essential features of their jobs and the precautions they must take in the course of their duties, and (*b*) in the large centres of industry a special lecture course (five or six lessons spread over a year, outside working hours) is available, which is designed to interest such grades as sand preparers, fettlers, moulding machine men, stove attendants, melters, and cupola-men.

Moulder and coremakers. Trade apprentices, consecutively or simultaneously, are given a double practical training in core-making and moulding. The course followed varies widely according to locality and the type of foundry. [Appendices IV to VII are cited here. No. IV details the training, lasting three years, for a foundry apprentice presumed to come from a primary school at 14 to 15 years of age. The first column shows that the boys may (1) enter an isolated foundry having no-one capable of giving any theoretical instruction; (2) a similar concern but one possessing such facilities; (3) a foundry in an industrial district; (4) a foundry operating an apprentice school; or (5) enter into a Trade Training Centre; these exist in 18 towns. In the case of No. 1, reliance is placed on men in the shop for his practical training. He works a 40- to 44-hr. week. A text-book to cover such cases is being prepared by the Foundry Employers' Association for publication next year; it will be issued to all foundries. Theoretical training is given by means of a correspondence course conducted by the employers' federation. It covers foundry technology and drawing. General education is similarly dealt with, and covers geometry, spelling, report writing, arithmetic, physics and chemistry. Instruction is given in social legislation, accident prevention and hygiene. This feature is common to all types of establishments. Boys will earn from 70,000 to 120,000 francs per year, plus family allowances, which are again a feature common to all. In the case of No. 2, the hours worked are the same (40 to 44), but the practical instruction is in the hands of a foreman or qualified moulder and both theory and general education are looked after by an "*ingenieur*" or other technician on the staff. The third case—that of a foundry in an industrial area—is exactly the same as the second, except that organised classes replace the internal theoretical and general-subject instruction. No. 4 follows much the same system as No. 3, except that the internal school replaces the co-operative system. Physical training—three hours a week—is given. The apprentices receive a lowered remuneration of 30,000 to 40,000 francs a year. Category No. 5—those entering the trade school—have 19 to 22 hrs. a week for practical work of graduated complexity. The theoretical course is extended to include natural science. The boys are given 4 hrs. a week for physical training and are also taught art work and singing. They receive 9,000 to 18,000 francs a year plus, of course, family allowances. Appendix V shows the annual distribution of hours (1,435 for the first and 1,505 for the second and third years) over the various subjects for the training centres, whilst appendices VI and VII give similar time-tables for the boys in isolated foundries and in concerns operating their own schools.] Though the normal duration of the apprenticeship is three years, it has been found possible, in certain cases, to award "craft diplomas" after two years, and even after 18 months, by means of a special examination.

Indentures and Wages

Apprentices who work in the shops and a certain number of students in the trade schools are bound by indentures to their future employers. [Appendix VII] is the form of Indenture used. Notable points are:—(1) Should the apprentice be absent for more than three weeks for illness, etc., then his apprenticeship is correspondingly lengthened, and (2) appropriate extracts from the law of the land are printed on pages 3 and 4 of the Indenture.]

In foundry workshops the hourly rates (including bonus) are as follow:-

1st half year	..	..	..	12 to 14 francs
2nd "	..	..	..	20 to 23 "
3rd "	..	..	..	22 to 27 "
4th "	..	..	..	28 to 34 "
5th "	..	..	..	33 to 37 "
6th "	..	..	..	38 to 47 "

In the training centres the Technical Education Authority accords grants varying between 9,000 and 18,000 francs a year for most of the students, who, also, are allowed a free mid-day meal in the school. They receive a complete training without any further charge upon their families.

The employers' payments cited in the Indenture and the family allowances, too, all go to improve this situation, and the trade training of youths is thus carried out without imposing too heavy a sacrifice on the part of the parents.

Training in French Foundries

Examinations and Competitions

Craft Diplomas. In the Paris region and in some other large cities, every year, apprentices participate in practical and theoretical competitions carrying with them as awards various prizes, medals, tools and saving certificates. At the conclusion of the apprenticeship, boards set up from the industry, trade unions and the educational authority examine the boys for an award of a Craft Diploma. The examinations are of a national character and include practical and theoretical tests.

Practical Test. For this, the apprentice has to make a mould and a core during a period of eight hours. The report takes into account speed of working, technical understanding and the appearance of the finished job.

Theoretical Work. The examination includes:—(1) Free-hand sketching of a given casting (2 hrs. is allowed); (2) a technological question, and (3) an oral examination on the reading of certain blue prints and on the technology of the trade. Only those obtaining on their report an average of 10 points out of 20 are passed, whilst five in any one subject fails the candidate. Those receiving fewer than 12 points in the practical examination are failed. Several hundreds of apprentices each year sit for the Craft Diploma, and of these about 65 per cent. pass.

Competition for the "Best Apprentice in France"

Every year, at the end of the session, the various districts in France enter one or more of their smartest and most advanced students for this competition. Those selected travel to Paris and the winner carries the title of "the best apprentice moulder in France." He receives a worthwhile money prize, is entertained to a banquet and excursions around the metropolis.

The Training of Technicians and Highly Qualified Workmen

This refers to the training of foundry toolmakers, modellers and metal patternmakers. This aspect has only had consideration during the last two years and is dealt with in appendices IX and IX*a*. [One document (IX*a*) shows that training can be carried out at a technical college and is of three years' duration. The first year (1,400 total hrs. or 40-hr. week) is sub-divided as follows:—Practical work, 577 hrs.; cultural, 70; general education, 420; physical training, 140; drawing, 140; technology, 17, and "civics," 35. The second year has a longer working week of 43 hrs., the extra time being devoted to practical work (647 hrs.) and technology (52 hrs.). In the final year, the week is one of 44 hrs., and the extra time is given over to practical training. The second one (IX) deals with three types of entrants. The first group is made up of the best foundry apprentices and the best draughtsmen from the Parisian trade schools. They receive training lasting a year in a special section of this Institute. For their practical training they are placed in the hands of a demonstrator who teaches them the rudiments of designing for moulding, and the technique of making metal patterns and the like. Theoretical training includes machine drawing and technology and ends in the submission of a thesis on a special job. General education includes French, mathematics, geometry, algebra and mechanics. The second group embraces those who have won entrance scholarships to the French technical colleges. The details proposed for their training have not yet been finalised, but follow on much the same lines as group one. Group three is made up of the best of apprentices just out of their time and trained in the works. Their practical training is not standardised, but centres around the normal production at the works. Theoretical training includes work in the drawing office, moulding studies and technical reporting; the progressive course is supervised by the works' manager, who is also responsible for the general subjects studied—geometry, trigonometry, algebra, physics, chemistry and mechanics.]

Training for Foremanship

Two methods are in use:—(1) The course on foremanship held in Paris and organised by the trade, and (2) by the national trade schools at Armentieres, Voiron, Lyons; St. Etienne; Epinal, Creil; Vierzon; and Nantes. [Appendix X details five courses catering for the various districts and types of entrant. They all receive some practical training, varying from 16 to 48 hours. Qualified teachers give instruction in technology; moulding studies; drawing and technical reporting, and also in general subjects—geometry, algebra; trigonometry, chemistry and mechanics.] In Paris, the foremanship courses are under constant revision, so that they may meet the needs of the average student. There are no fees and the courses operate as follows:—Youths possessing a Craft Diploma, or skilled artisans, are selected by an entrance examination. They continue to work in their places of employment for five days a week and receive instruction on a Saturday and complete their knowledge by undertaking home-work. [Appendix XI shows that the course lasts 3 years. It involves a 2,280-hr. year (including home-work), or a 49-hr. week. Outside shop hours, 120 hrs. are given over to each of three subjects —machine drawing; technology and general knowledge, half of which is arranged as home-work.]

The instruction given includes, amongst other things, draughtsmanship, foundry technology, many moulding studies, defects in castings, plus some lessons in electricity, algebra, physics, trigonometry and mechanics. Independently of this normal tuition, it has been deemed wise to include some aspects of leadership, such as the taking of responsibility; the showing of initiative, the exercise of powers of observation, of control and of human relationships.

After three years of study the young men, who have assiduously followed the course, can sit for the trade certificate, which pronounces that the successful candidate has the requisite qualifications for foremanship in specified subjects. The examination includes both theoretical and practical subjects.

Practical Tests. These embody the carrying-out of a really difficult mould with its necessary cores in 9 hrs.

Theoretical Examination. This includes technology; moulding studies; physics; chemistry; electricity; geometry, trigonometry and mechanics. A technical report, illustrated by a free-hand drawing, has to be submitted. Candidates who reach a general average of 12 points out of 20 are passed, if they have shown at least 12 points in the practical examination. A standard lower than 8 out of 20 in any subject involves disqualification. One point should be noted. Those selected to take the foremanship course are subjected to a careful psycho-technical examination, which clearly shows up their potentialities.

Only candidates who pass the test set out in [Appendix XII-XII*a* are put in charge of youngsters. [Appendix XII is a chart showing the reporting of a psychological examination. It is divided into two main headings—" Aptitudes and Tendencies "; squared paper, carrying nine numbered vertical lines, is equally divided and labelled " poor," " medium " and " good," and there is a final column for " observations." In the first column there are 39 headings and amongst the more important of these are " manual dexterity "; " concentration "; " observation "; " mental retention of shapes "; " rapidity of understanding "; " loyalty "; " sense of responsibility "; " self-control "; " confidence "; energy," and " perseverance." Points are recorded against each heading and a graph is constructed. Appendix XI*a* is a copy of an actual report.]

Young people not showing the requisite aptitudes for full control will be able to take staff positions in connection with technical control, placing orders, planning or laboratory work. This year, an additional adjunct is being required from future foremen—that of a rapid appreciation of the disposition and character of individuals. Six lectures are being organised with this object in view, treating of graphology, morphology and bearing.

Training for Management

For 26 years there has been in exisitence a " foundry college." This was originally created by the *Syndicat Général des Fondeurs de France* (the employers' organisation); it trains the " *Ingénieurs* " for the industry. Recruitment is assured by accepting (1) a proportion of the " *Ingénieurs* " who have been trained in the national engineering colleges, and who have spent at least a year in a foundry, and (2) some of the brightest youths who have passed the foremanship examination. These certificated youths take a two-years' special course to prepare them for the entrance examination. The locations of the schools are shown on the map (Appendix I). The session at the " Foundry College " lasts a year, and turns out between 20 and 35 certificated " *ingénieurs* " at the conclusion of each course. The syllabus is very specialised and includes:—

General Subjects: Siderurgie; metallography; equilibrium diagrams; applied chemistry; industrial heating; pyrometry; sands and refractory materials; foundry defects; moulding studies (patternmaking, moulding and casting); machine moulding; core-making; drying; fettling; work routing, etc.

Special Subjects: Moulding and metallurgy (iron, steel, malleable, non-ferrous and light alloys).

Practical Work: Chemistry; metallography; moulding studies; shop work (visits to foundries and reports on these visits); plant lay-out—particular and general.

Theoretical studies are reinforced by works' visits and by attendance at the meetings of the *Association Technique de Fonderie* (the French counterpart of the Institute of British Foundrymen). At the end of the session, a final examination indicates credits, and its passing bestows upon the candidate the title of *Ingénieur de l'Ecole Supérieure de Fonderie.* For passing, the candidate must attain a general average of 14 points out of 20. To mark the success of the candidates in a concrete manner, each is given a special certificate (*un livret professional*) which details their behaviour and examination placings.

Workmen's Upgrading—Accelerated Trade Training

Works Initiative. The semi-skilled workmen in French foundries receive no special or complementary training for fitting them for their jobs. They are taken from the ranks of the unskilled and taught their new jobs in the actual foundries. A similar operation is likewise undertaken to convert the semi-skilled into skilled men, but the results are evidently less satisfactory in this case.

The Work of the Industry and the Directors

To help the good work of foundry directors and to aid in the improvement of their staffs, the employers' organisation has taken three steps:—

(*a*) *The provision of the services of the National Institute of Training for Management.* Courses of three months' duration are organised in the Institute for those deemed suitable ultimately for teaching others. Here, a thorough insight into management is imparted through the giving of graduated tuition and the holding of discussion groups. (The participants are housed and fed free of charge. They receive their salaries by means of grants made by the Ministry of Labour.)

(*b*) *Creation of Co-operative Centres for Accelerated Trade Training at Marseilles and Charleville.* The students for six months undergo an intensive training—both practical and theoretical—to suit them for the jobs for which they wish to qualify. They are housed and fed free of charge and receive their normal wages, the conditions being regulated by the Ministry of Labour.

(*c*) *Up-grading Classes.* This project, now being organised in the Paris region, will help labourers and semi-skilled men to raise themselves to a higher grade. Candidates for promotion will follow a special course every Saturday in certain of the apprenticeship centres, and will participate, at the end of a year, in the examinations and competitions organised by the industry. The expenses of the class are taken care of by the Technical Education Authority.

The Organisation of Apprenticeship

Division of Interests. Only about ten years ago, apprenticeship was almost exclusively carried out in the works. Since that time, employers' associations,

Training in French Foundries

both national and regional, have made considerable efforts to accelerate, co-ordinate and help private initiative. Worthwhile results have been achieved, but Government assistance is necessary where it has been found desirable to open well-equipped schools, so designed as to conform with the ever-increasing needs of the technician and skilled man. The work undertaken by the Educational Authorities, the individual works, and the industry, are detailed in Appendix XIII.

[The documents show that the co-ordinating authority is the National Commission for Trade Training. The Government effort operates through the services of the Technical Education Department and the management of the various State schools. It participates in the "up-grading" courses held in the apprenticeship centres; in the training of pattern moulders and the like, and in foremanship courses.

The next section is governed by ten regional commissions of the employers' federation. It organises regional apprenticeship schools and a correspondence course for theoretical subjects. For foremanship, there is a course held in Paris and, for the rest, there is a correspondence service. Finally, of course, for training the management, there is the Foundry College, the Technical Institute, and lecture courses organised by the *Centre Technique*. To conclude, the chart shows the efforts made by the individual works for the training of skilled and highly skilled foremen and managers. This includes a note to the effect that under this system the foremen are clearly weak in theory.]

The Activities of the National Commission for Trade Training

Representation by qualified individuals for this Commission is drawn from all areas. Management is its main activity, but it also undertakes:—

(1) Propaganda and recruitment.
(2) Supervision and development of trade training at all levels.
(3) Staff salaries discussions.
(4) Publishing and revision of text books.
(5) Unification of apprenticeship courses.
(6) Research and the training of lecturers for the various classes.
(7) The creation of fresh centres and the extension of existing ones.
(8) The organisation of examinations and the competition for the "Best apprentice moulder in France."

Activities of the Specialised Permanent Service of the Employers' Federation

In brief, the important activities of this body are as follow:—

(1) Liaison between the National and Regional Commissions.
(2) Collection and dissemination of statistics and reports on apprenticeship.
(3) Relations with the individual works.
(4) Relations with the Technical Education Authority.
(5) Relations with the services, training centres, upgrading classes, technical colleges, and the national trade schools.

Methods of Training

To ensure the training of its personnel of all grades, the foundry industry has prepared or is preparing a series of textbooks, which will treat, objectively, with all questions dealing with practical and theoretical training. Moreover, and especially for the isolated works, there are the correspondence courses. These institutions set exercises and correct the Papers in such a manner as to give a thorough preparation for the various examinations.

[Appendix XIV lists the books specially prepared for the semi-skilled, skilled, high-skilled workmen, foremen and staff.]

Social Aspects of Problem of Trade Training

(*a*) The ever-increasing complexity of the technicalities of the craft demands a longer training period for future craftsmen. In order to encourage families to co-operate with these efforts, the French foundry industry is envisaging the creation of money awards to all youths who study for the trade or prepare themselves to become foremen.

(*b*) Quite recently, the industry has made a vigorous effort to re-equip the plants, with the result that there has been a noteworthy improvement in working conditions with pleasing repercussions on recruitment and retention of workpeople.

(*c*) Finally, the Author points to the creation of a large holiday centre, which is annually visited at very low cost by hundreds of apprentices and the workmen's children.

Conclusions

It is impossible, within the space available to a Paper of this type, to describe all the desirable developments connected with this important subject of Training for Industry. No place has been found for a discussion on the various methods used, nor of the financial problems involved. Moreover, it has not been possible, because the work is still unfinished, to show the distribution of the training in the various districts. Whilst regretting the gaps that exist in this Paper, the Author asks foreign technical associations to reciprocate by informing the French authorities of the steps they take to train the youth of their industry.

Doubtlessly, a similarly efficient co-operation exists, and the Author hopes that in all countries and at all levels the foundry will be cited as an industry where method, the spirit of progress, solidarity and generosity are paramount.

LIST OF APPENDICES

I. Les Principaux Centres de Fonderie en France. (Map showing the Principal Foundry Centres in France.)
II. Extraits d'une Fiche Scolaire. (Extracts from a Schedule to be completed by each Entrant for Examination.)
III. Monographie Sommaire du Mouleur. (Moulders' Duties, Tools, Working Conditions.
IV. La Formation du Mouleur Noyauteur. (Moulder-Coremaker Training Scheme.)

(*Continued on page 25.*)

Mechanical Properties of Some Copper-base Alloy Castings*

A Communication from the Technical Committee of the Association of Bronze and Brass Founders

INTRODUCTION

Progress in modern engineering design demands parallel progress in materials of construction, and the latter may be realised in two different ways: First, by the development of new materials with intrinsically better properties, and secondly, by improvements in manufacturing technique by which the properties of the service component are made to approach more and more nearly to the maxima possible in the materials used. The second of these alternatives is a specially fruitful line of attack on the general problem in the case of castings, since these are probably more liable to suffer damage to their properties by certain defects than are most other forms of metal products.

The Sub-committee finally responsible for producing this Paper was comprised of Mr. F. C. Evans (Chairman), Mr. W. A. Baker, Mr. G. T. Callis and Mr. F. Hudson.

The Report, which is of a preliminary nature, compares the properties of castings with those of Standard Test-bars.

The extent to which the properties of castings are actually impaired by these defects depends upon three main factors: First, the intrinsic casting characteristics of the material used; secondly, the precise form of the casting demanded by the designer, and thirdly, the skill and experience of the manufacturer. Improvements in the quality of the cast product may therefore be sought along several lines, *e.g.*:—

(*a*) By co-operation between designer and manufacturer with a view to evolving designs which will meet the designer's requirements, and at the same time be conducive to the production of a sound casting.

(*b*) By improvement in manufacturing technique derived from the results of fundamental research allied with manufacturing experience.

(*c*) By research which promotes a better understanding of the casting characteristics of the materials and to provide materials with improved casting characteristics.

Great advances have been made along these lines in the case of light-alloy castings upon which the exacting requirements of the modern aircraft industry have imposed a high standard of quality, and the need for such advances in copper-base alloy castings has become increasingly apparent in recent years. One consequence of the realisation of this need was the publication two years ago by the British Standards Institution of a Code of Procedure in the Inspection of Copper-Base Alloy Sand Castings (B.S. 1367:1947). This code indicates inspection procedures designed to give the maximum possible information on the properties of such castings with the minimum expenditure of materials, time and labour, and its ultimate objective is to assist both designer and founder in improving the quality of the castings.

The following quotations from this Standard should be particularly noted:—

"*Co-operation between Designer and Manufacturer*"

"It is desirable that the designer should collaborate with the manufacturer at the earliest possible stage. The designer is interested in ensuring that the material in the casting has adequate strength and ductility or other desired properties to withstand the conditions which will be imposed in service. In some cases his attention is concentrated on certain critical positions and he requires special assurance as to the properties in these sections. Consultation with the founder at an early stage in design helps to avoid the inclusion of features which are not essential to the design, and which seriously increase the difficulty of producing a sound casting. Such consultation also enables the founder to make suggestions for modifications, which will simplify, and therefore expedite and cheapen, production and inspection."

"*Mechanical Tests on Standard Test-bars*"

"It is emphasised that neither integral test-pieces on the casting nor separately-cast test-bars normally exhibit mechanical properties which are representative of the properties of the casting."

"The separately-cast test-bar is usually a simple form of casting which can be made substantially free from deleterious features such as porosity and internal stresses, and may have a cross-section larger or smaller than that of the casting and in consequence may differ in grain size and micro-structure from the casting

*Presented by Mr. F. C. Evans on behalf of the Committee to the Cheltenham Conference of the Institute of British Foundrymen, June, 1949.

Copper-base Alloy Castings

itself. It is known from experience that test-bars cannot be designed to have the same features as the castings represented, and for purposs of inspection the test-bar properties can theretore only be regarded as an indication of the properties which the metal poured is capable of giving and of the control exercised in the foundry."

"Integral test-pieces "cast-on" the casting in general do not give more information about the mechanical properties in the casting than do separately-cast test-bars. The properties of the metal vary from place to place in the casting in accordance with the local conditions of rate of cooling and access to feeding metal. In these circumstances the "cast-on" bar is as much a special case as the separately-cast bar, when considered in relation to the properties throughout the casting. It may be said that identity of composition between the casting and the test-piece is assured when "cast-on" bars are used, but this can equally well be assured by proper identification of separately-cast test-bars and castings poured from the same melt. The "cast-on" bar has several disadvantages, *e.g.*, its presence may cause local porosity in the casting, it may impede the free contraction of the casting, or it may interfere with the use of the correct pouring temperature for the casting. In these ways the "cast-on" bar may be detrimental to the casting itself, and for these reasons it is strongly recommended that separately-cast test-bars should be used."

Mechanical tests on separately-cast test-bars should be regarded as supplementary to chemical analysis; they are a means of ensuring that the metal actually cast in the foundry is capable of giving the specified mechanical properties. In this sense the test-bar properties are to be regarded as affording information about the metal cast for specific jobs, but they may be equally well interpreted in a wider sense as an indication of the technical control exercised in the foundry. Thus, where the type of production permits, the test-bar results over a period may be of value to the inspector in enabling him to form an opinion of the degree of technical control in force, and from this to determine the extent of inspection where this is partly left to his discretion.

The code goes on to recommend certain procedures to be followed in assessing the serviceability of castings:—

"Reference may be made to the mechanical properties of specimens cut from the casting itself. While it will be for the designer to indicate the position and orientation of such test-pieces, the properties to be specified for them can only be decided by consultation between designer and manufacturers, and this may involve experimental investigation."

At the present time no useful information is available on the mechanical properties of typical commercial copper-base alloy castings, and the work described in this Report was undertaken to provide such data. It seemed desirable in the first instance to take typical samples of various types of casting from normal production, and accordingly members of the Association of Bronze and Brass Founders were invited to carry out certain specified tests on sample castings from their current production. Twelve members of the A.B.B.F. carried out the required tests on castings taken from their regular production, and the data are summarised in this Report. The scope of this preliminary survey was as follows:—

Types of Castings examined: (*a*) Simple forms—bearing bushes, gear wheels; (*b*) structural members—brackets; (*c*) castings for hydraulic service—valve bodies, and (*d*) chill castings and chill-cast sticks and bushes.

Alloys: Under the classes (*a*) Phosphor-bronze or gunmetal; (*b*) and (*c*) gunmetal, high tensile brass, aluminium bronze, and (*d*) phosphor-bronze.

Data Recorded: (*a*) Casting records to include (i) Metal composition; (ii) casting temperature; (iii) photographs or drawings of castings, wherever possible, showing details of method of running and feeding, and (iv) properties of sand used for moulding.

(*b*) Mechanical and other properties to include (i) Tensile tests on separately-cast test bars; (ii) pressure test on the casting, where applicable; (iii) density of test-bars and of specimens cut from the casting; and (iv) tensile, hardness and impact tests on specimens cut from recorded positions in the casting, the tensile data including 0.1 and 0.5 per cent. proof stresses.

The complete data were not available in all cases, the notable omissions being density, impact and proof-stress data. In many cases, yield points were quoted; these are recorded under the 0.5 per cent. proof stress heading and they are indicated with an asterisk because the strains to which they correspond were not accurately defined.

Method of Presentation

The data is presented:—(i) In a series of annotated photographs or drawings which give the casting records for a particular casting or group of castings, and (ii) a table for each group summarising the mechanical properties determined on separately-cast test-bars and specimens from the castings.

Results.—The tables are divided into sections according to types of alloy for convenience in comparing properties of different types of castings in similar alloys. The drawings and data follow the same sequence as the mechanical properties in the Tables.

Conclusions

The scope of the work was necessarily limited because of the costly sectioning and testing required and to a lesser extent because of difficulties in withdrawing sample castings from current production. Consequently the number of results available for any one type of casting is too small to warrant any definite conclusions being drawn, although a few observations may be offered.

In the first place, it is generally believed that castings in alloys with a short freezing range, the so-called high-shrinkage alloys typified by aluminium bronzes and high-tensile brasses, can be made completely

sound and with properties equal to those of separately-cast test-bars with similar cross-section thicknesses, provided the metal is not gassy and castings are properly fed.

The test results for these alloys support this view, although it will be observed that some of the high-tensile brass specimens cut from the castings have poor mechanical properties; in these cases the castings

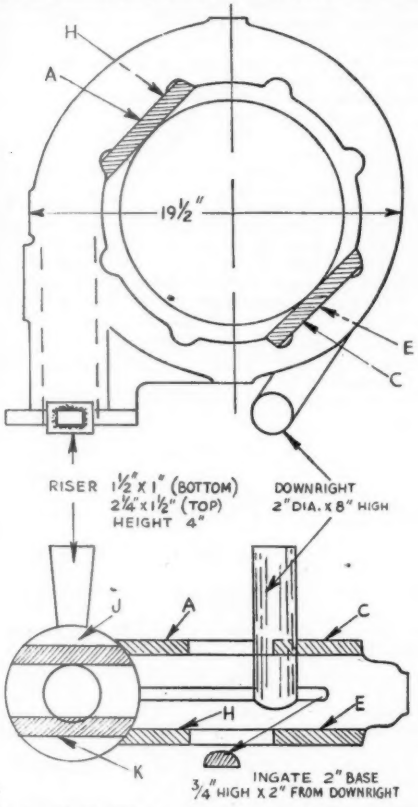


FIG. 1.—CASE NO. 1. SAND-CAST PHOSPHOR BRONZE PUMP CASING.

involved were of such a design that the parts from which the specimens were cut could not properly be fed.

On the other hand, it is well known that alloys with long freezing ranges are liable to contain dispersed porosity which reduces their mechanical properties, although not necessarily to such an extent as to impair seriously their serviceability. The tests on the valve and pump bodies illustrate the latter point: the castings concerned, or their duplicates, passed pressure tests satisfactorily although some of the tensile test specimens cut from the castings had much lower properties than the separately-cast test-bars.

In alloys of this type, steep temperature gradients are required, in the right directions, to ensure good feeding, and the resulting improvement in mechanical properties is illustrated by the data for the chilled gear blanks and for the chill-cast sticks, the latter having the best properties where the temperature gradients were made most favourable by controlled slow pouring.

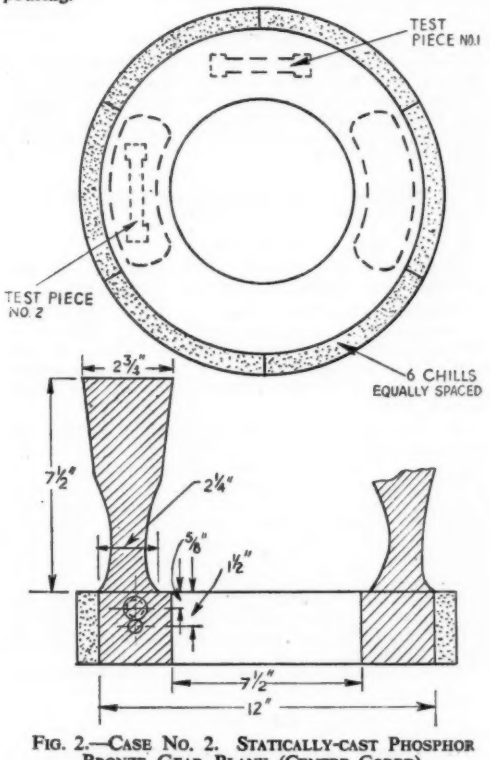


FIG. 2.—CASE NO. 2. STATICALLY-CAST PHOSPHOR BRONZE GEAR BLANK (CENTRE CORED).

An unsatisfactory feature of cut-up tests is that it is impracticable in most cases to test specimens from those parts of the casting likely to have the poorest properties, that is, from parts such as junctions of sections, etc., where solidification is locally delayed.

The main conclusion to be drawn from this preliminary work is that many more tests must be carried out to provide the background of information

required by designers and manufacturers of castings in copper-base alloys. Improvements in the quality of castings cannot fail to materialise, if data of this kind is made available, because it will enable designers and manufacturers to recognise and avoid bad features in design and unsatisfactory methods of manufacture.

It is recommended that further work should include tests upon a specially designed test casting incorporating the features of a typical production casting but so dimensioned as to permit of full investigation of both properly- and inadequately-fed portions.

Acknowledgments

The Technical Committee of the Association of Bronze and Brass Founders gratefully acknowledges the help and co-operation of those firms who supplied the results on which this Paper is based, and also the work of the sub-Committee which finally formulated this communication.

GROUP 1 (a)—PHOSPHOR BRONZE, SAND CAST

Case No. 1

Description.—Centrifugal pump casing, 19½-in. outside diameter; weight, 116 lb.; illustrated in Fig. 1.

Material.—Phosphor bronze to B.S.S. 1400-PB3-C; its actual composition being:—Cu 90.20 (balance by difference), Sn 9.15, Pb 0.05, Zn 0.21, Fe 0.03, Ni 0.06, and P 0.30 per cent. Both the zinc and phosphorus are slightly above the maximum called for in the specification.

Method of Casting.—Dry-sand moulding practice was used, the sand having the following properties:—Moisture 6.5 to 8.5 per cent.; green compression, 6 to 8 lb. per sq. in.; green permeability, 30 to 35; dry compression, 65 to 150 lb. per sq. in.; and dry permeability, 45 to 60. Standard A.F.S. tests were used. The core sand consisted of Southport silica sand bonded with a semi-solid oil binder, and the cores were coated with "Terracoat."

The pouring temperature of the casting was 1,090 deg. C., and of the separately-cast test-bars, 1,100 deg. C. A duplicate fully machined casting passed the hydraulic test of 200 lb. per sq. in.

The mechanical properties are set out in Table I(*a*).

Case No. 2

Description.—Gear blank, statically (chill) cast. It was 12-in. diameter, 7½-in. bore, 2½ in. thick, and is illustrated in Fig. 2.

Material.—Tin bronze to B.S.S. 1400, PB2-C, its composition being:—Cu 88.80, Sn 9.58, Pb 0.03, Zn trace, Fe 0.05, Ni 1.02, and P 0.27 per cent. The tin content was approximately 1½ per cent. below the minimum and the nickel content was ½ per cent. above the maximum of the figure called for by the above specification.

Method of Casting.—Dry-sand mould, shown in Fig. 2, completely chilled around the periphery.

The properties of this sand (A.F.S. tests), which was of the Mansfield red type, were:—Moisture, 6.8 per cent.; green compression, 5.2 lb. per sq. in.; green permeability, 18.0; dry compression, 105 lb. per sq. in., and dry permeability, 20. The mould was dried for 8 hrs. at 500 deg. F (260 deg. C.).

The pouring temperature was 1,220 deg. C. As a special test it was radiographically examined by gamma-rays and, apart from slight surface porosity in the location of the ingates, was found to be free from internal defects of the heavy type.

The mechanical properties are set out in Table I(*a*).

Case No. 3

Description.—A gear blank, 12 in. by 1½ in., weighing 60 lb., shown in Fig. 3.

Material.—Phosphor bronze, conforming to B.S.S. 1400-PB2-C. Its actual composition was:—Cu 87.4, Sn 10.56, Pb 0.14, Fe 0.014, Ni 1.23, and P 0.38 per cent. The tin content was ½ per cent., approximately, below the minimum and the nickel ¾ per cent. above the maximum of the figures called for by the above specification.

Method of Casting.—(See Fig. 3.) The casting was made in a dry-sand mould, completely chilled around the periphery.

The properties of the sand used (A.F.S. tests) were as follow:—

	Facing.	Backing.
Moisture	7.5 per cent.	9.0 per cent.
Green compression .. (Lb. per sq. in.)	5.4 to 6.5	3.8
„ permeability	56·5 to 58·8	54.5
Dry compression .. .. (Lb. per sq. in.)	93.5 to 102	16.15
„ permeability	83.5 to 90.1	69.4

The pouring temperature was 1,140 deg. C. and the mechanical properties are detailed in Table 1(*a*).

Case No. 4

Description.—The castings in this case were a series of bushes of the following dimensions and weights:—

Bushes:

(*a*) 3 in. i.d. × 5⅜ in. o.d. × 11 in. weighing 47 lb. (See Fig. 4.)

(*b*) 5½ in. i.d. × 6⅞ in. o.d. × 5½ in. weighing 20½ lb. (See Fig. 5.)

(*c*) 4⅛ in. i.d. × 5⅞ in. o.d. × 7½ in. weighing 21½ lb. (See Fig. 6.)

(*d*) 2 in. i.d. × 3½ in. o.d. × 12 in. weighing 13½ lb. (half bush). (See Fig. 7.)

Material.—Phosphor bronze to specification B.S.S. 1400-PB1-C. The actual composition was: Cu 88.9; Sn 10.09; Pb 0.13; Ni nil; and P 0.62 per cent.

Methods of casting.—These are illustrated in Figs. 4, 5, 6 and 7. Both the moulds and the cores were

made in dry sand, the (A.F.S. test) properties of which were as under:—

	Facing.	Backing.
Moisture	7.5 per cent.	9.0 per cent.
Green compression .. .. (lb. per sq. in.)	5.4 to 6.5	3.8
„ permeability	56.5 to 58.8	54.5
Dry compression .. .. (lb. per sq. in.)	93.5 to 102.0	16.15
„ permeability	83.5 to 91.1	69.4

The pouring temperature was from 1070 to 1050 deg. C. The mechanical properties are detailed in Table 1(*b*).

Case No. 5

Description.—This was the pump body shown in Fig. 8. The body was approximately 7 in. diameter and 10 in. over the pipe flanges.

Material. — Phosphor bronze sand cast. Its composition was Cu 88.75; Sn 10.6; Pb 0.044; Fe 0.015; Ni 0.066; and P 0.34 per cent. This composition did not comply with any British Standard Specification but fell between B.S.S.1400-P.B.7 and P.B.3 in which the phosphorus contents are 0.5 per cent. minimum and 0.25 per cent. maximum respectively.

Method of casting.—A dried sand mould, shown in Fig. 8, was used. The properties of the sand were exactly the same as in case No. 4.

The pouring temperature was 1100 deg. C. and the mechanical properties are detailed in Table 1(*a*).

Case No. 6

Description. — This case relates to bushes of 5½ in. o.d., 4 in. i.d. by 7 in. long. (See Fig. 9.)

Material.—Phosphor bronze conforming to B.S.S. 1400-PB2-C. (0.35 per cent. P).

Method of casting.—As is shown in Fig. 9, wherein both the sand mould and the oil sand cores were dried.

Bromsgrove sand was used containing 6 per cent. moisture.

The pouring temperature was between 1100 to 1095 deg. C. and the mechanical properties are detailed in Table 1(*a*).

GROUP 1 (b)—CHILL CAST PHOSPHOR BRONZE

Case No. 7

Description.—This case relates to a gear blank, centrifugally cast, made in an 11 per cent. tin bronze; it was 12 in. diameter, 7½ in. bore, and 2½ in. thick. It is shown in Fig. 10.

Material.—The casting was made to conform with tin bronze, BSS, 1400-PB2-C. Its composition was Cu, 89.00; Sn, 10.48; Pb, trace; Zn, 0.05; Fe, 0.02; Ni, 0.12, and P, 0.20 per cent. The tin content was approximately ½ per cent. below the minimum called for by the specification.

The core sand mixture used for the runner cores was: Glyso, 6, and dried Southport sand, 94 per cent. The cores were baked at 230 to 255 deg. C. and sprayed whilst still warm with an alumina-base paint which was allowed to air dry.

The properties of this sand were:—Green compression: 1.8 lb. per sq. in.; green permeability: 165; dry compression: 940 lb. per sq. in.; dry permeability: 170, and dry transverse strength, 62 lb. per sq. in.

The pouring temperature was 1,160 deg. C.

A special test with radiographic examination by gamma-ray was undertaken. It revealed that apart from slight surface porosity in the location of the ingates the casting was free from internal defects of the heavy type.

The mechanical properties are shown in Table 1(*b*).

Case No. 8

Description.—This case covers chill cast sticks of the following sizes: (*a*) 4 in. solid, weighing 41¼ lb.; (*b*) 2 in. by 4 in. cored; (*c*) ¾ in. by 2 in. cored, weighing 24 lb.; (*d*) 2 in. solid, weighing 27½ lb., and (*e*) 1 in. solid, weighing 6½ lb.

Material.—Phosphor Bronze. They were made to conform with B.S.S. 1400-PB1-C. (Phosphor Bronze). The composition was: Cu, 88.28; Sn, 10.14; Pb, 0.028; Fe, 0.005; Ni, 0.044; Zn, 0.005, and P, 1.46 per cent.

Casting.—The castings were chill cast, using controlled pouring by means of jet runners of the following sizes:—

Sample No.	Jets.	Pouring time.
26	One of ⅛ in. dia.	77 sec.
28	Four „ ¼ in. „	128 „
30	One „ ¼ in. „	227 „
32	One „ ½ in. „	157 „
36	One „ ½ in. „	72 „

The pouring temperatures for the various sticks were:—(*a*) 1,240 to 1,220 deg. C.; (*b*) 1,220 to 1,190 deg. C.; (*c*) 1,240 to 1,180 deg. C.; (*d*) 1,250 to 1,200 deg. C., and (*e*) 1,230 to 1,220 deg. C.

Mechanical properties are detailed in Table 1(*b*).

Case No. 9

Description.—In this case five chill-cast phosphor bronze bars were studied. These carried the following dimensions:—(*a*) 1 in. dia. by 12 in. long; (*b*) 1 in. dia. by 24 in. long; (*c*) 1½ in. dia. by 24 in. long; (*d*) 2 in. dia. by 24 in. long; (*e*) 2½ in. o.d. by 1½ in. i.d. (cored bars).

Material.—Actual composition was made to conform with B.S.S. 1400-PB1-C, thus:—Cu, balance (by difference); Sn, 10.32; P, 0.90; Zn, 0.03; Pb, 0.02, and Fe, 0.03 per cent.

The pouring temperature was 1,100 deg. C., and the mechanical properties are detailed in Table 1(*b*).

Case No. 10

Description. — This case refers to a chill-cast rod, 1 in. dia. by 24 in. long.

Material.—Made to conform with Phosphor Bronze (0.5 to 0.6 per cent. P), B.S.S. 1,400-PB1-C.

The pouring temperature was from 1,100 to 1,120 deg. C., but no controlled pouring methods were used. The mechanical properties are shown in Table 1(*b*).

(*To be continued.*)

TABLE I (*a*).—*Sand-cast Phosphor Bronzes.*

Case No.	Type of casting.	Description of test samples.	Cast Section thickness in. ins.	0.1 per cent. P.S., tons p.s.i.	0.5 per cent. P.S. or yield point, tons p.s.i.*	U.T.S., tons p.s.i.	Elongation per cent.	Hardness No. (Brinell).	Izod impact ft. lb.
1	Centrifugal pump casing 19¼ in. o.d.	Specification requirements, B.S.S. 1400-PB3-C				16	10		
		Separately cast test bars	¾			15.3	16		
		Sample No. A	¾			13.3	12		
		,, C	¾			9.9	6		
		,, E	¾			11.3	8		
		,, H	¾			13.0	12		
		,, J	1			14.8	12		
		,, K	1			14.4	14		
2	Statically cast gear blank, 12 in. o.d. × 7½ in. i.d. × 2½ in. thick	Specification requirements, B.S.S.-PB2-C			{ Sand { Chilled	14 17	7 3	69 90	
		Separately cast bar 1 (Sand)				18	13		(T piece 0.45 dia.) 15 : 16 : 16
		Separately cast bar 2 (chilled)				24	16		18 : 16 : 14
		Sample No. 1	2½	11.2	12.6	22.4	25		14 : 12 : 12
		,, 2	2½	10.8	12·2	16·4	10		
						Top surface 92.3/107 Bottom surface 101/107			
3	Gear blank, 12 in. dia. × 1½ in. thick	Specification requirements, B.S.S. 1400-PB2-C :—							
		Separately cast bar (sand)				14	7		
		Cut from periphery (chill cast)				15	2	82	
		Separately cast test bars		10.09	16.65	19.2	14.5	89.7	5.5
		Sample No. 1	1½			22.8	18		
		,, 2	1½					92.3	7.0
		,, 3	1½	10.05	11.55	18.9	16.5	95	7.0
		,, 5	1	9	10.32	10.4	1.5	80.4	
		,, 6	¾	9	10.2	11.2	2.1	82.6	
		,, 7	¾						Segregated fracture 2 : 2 : 3
		,, 8	¾						Segregated fracture 3 : 2½ : 2½
4		Specification requirements, B.S.S. PB1-C				12	1.5		
		Separately cast test bars		8.78	10.55	15.5	8.9	104	4 : 3 : 3
	Bushes 3in. i.d. × 5⅜ in. o.d. × 11 in.	Sample No. 1	1	8.13	9.8	13.2	6.1	114	4 : 5 : 5
	5½ in. i.d. × 6⅜ in. o.d. × 5½ in.	,, 2	¾	7.62	9.25	12.8	5.9	101	4 : 3 : 4
	4⅜ in. i.d. × 5¼ in. o.d. × 7½ in.	,, 3	⅝	8.99	11.05	12.8	3.1	104	3.5
	Half bush, 2 in. i.d. × 3½ in. o.d. × 12 in.	,, 4	½	8.6	11.05	14.8	7	104	4.0
5	Pump body, 7 in. dia.	Specification requirements. No British Standard—see note in report.							
		Separately cast test bar		8.7	10.4	15.5	10	84.4	7
		Sample No. 47 (flange)	⅞	9.32	11.66	13.55	6	78.3	6 : 6 : 5
		,, 48 (housing)	1	9.0	11.15	13.9	7	80.4	7
6	Bush, 5¼ in. o.d. × 4 in. i.d. × 7 in.	Specification requirements, B.S.S. 1400-PB2-C				14	7	69	
		Separately cast test Bar PB2			11.2*	14.8	12.5		
		Sample No. P.B. 1 ..	½		11.2*	14.0	8		

Specific gravity.	Remarks and test bar details.
	0.564 in. dia.
	"
	"
	"
	"
	"
	0.564 in. dia.
	"
	"
	"
8.43	0.564 dia. Taken from chilled periphery.
8.4	
8.08	
8.13	0.564 in. dia. Taken from centre underneath riser.
8.53	0.564 in. dia.
8.48	"
8.43	"
8.41	"
8.49	"
8.39	0.564 in. dia.
8.17	"
8.22	"
	0.564 in. dia.
	"

FIG. 3.—CASE NO. 3. STATICALLY-CAST PHOSPHOR BRONZE GEAR BLANK. (SOLID CENTRE.)

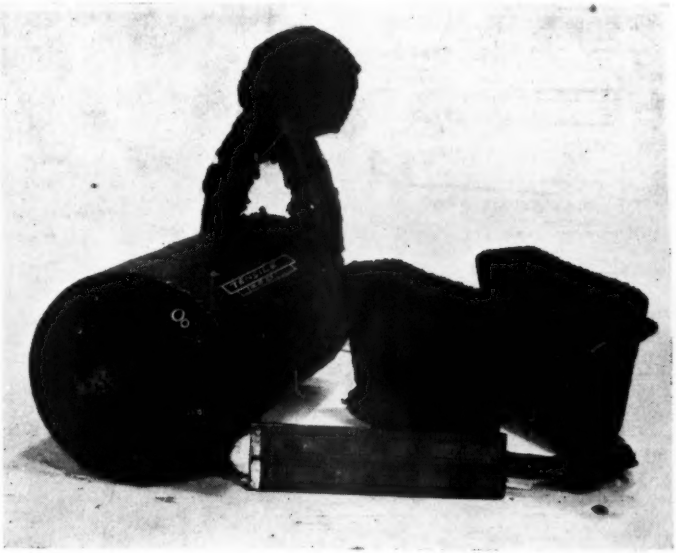


FIG. 4.—CASE NO. 4. SAMPLE 1. PHOSPHOR BRONZE BUSH. CASE NO. 17. SAMPLE 5. LEADED GUNMETAL BUSH.

TABLE I (*b*).—*Chill-cast Phosphor Bronzes.*

Case No.	Type of casting.	Description of test samples.	Cast section thickness, in ins.	0.1 per cent. P.S., tons p.s.i.	0.5 per cent. P.S. or yield point, tons p.s.i.*	U.T.S., tons p.s.i.	Elongation, per cent.	Hardness No. (Brinell).	Izod impact, ft.-lbs.
7	Centrifugally cast. Gear blank 12 in. o.d. × 7½ in. i.d. × 2½ in. thick	Specification requirements B.S.S. 1400-PB2-C				**17**	**3**	90	(T piece 0.45 dia.)
		Separately cast test bars				21.6	9.5		4 : 4 : 4
		Sample No. 1	2½	10.4	13.9	23.2	7		5 : 4 : 4
		„ 2	2½	10.2	12.8	21.8	13		4 : 4 : 3
						Chilled face ..		101	
						Bore		85	
	Chill cast sticks, 4 in. o.d.	Specification requirements B.S.S. -PB1-C				**16**	**1.5**		
	„ „	Sample No. 26.. ..	4	11.28	15.4	19.72	2.6	140	1 : 1.5 : 1
	„ „	„ 27.. ..	4	12.6	15.68	25.68	10.0	128	2 : 2.5 : 2
	„ „	„ 39.. ..	4	12.52	17.45	19.5	2.2	125	
	„ „	„ 40.. ..	4	12.48	15.68	25.2	8.4	127	
	„ „	„ 41.. ..	4	12.4	15.44	25.4	10.0	127	
	„ „	„ 42.. ..	4	12.21	16.55	19.75	2.3	127	
	4 in. o.d. × 2 in. i.d..	„ 28.. ..	1	11.8	15.4	21.0	3.1	117	1.5 : 1.0 : 1.5
	„ „ „	„ 29.. ..	1	11.4	14.4	21.2	6.3	114	2 : 1.5 : 1.5
	2 in. o.d. × ⅝ in. i.d..	„ 30.. ..	⅝	13.0	16.6	25.1	6.6	117	1 : 1.5 : 1
	„ „ „	„ 31.. ..	⅝	13.36	17.04	26.4	6.1	117	1 : 1 : 1
	2i n. o.d.	„ 32.. ..	2	13.5	17.8	23.95	3.2	129	1.5 : 1.5 : 2
	„	„ 33.. ..	2	13.44	17.28	22.8	4.5	126	1 : 1.5 : 1
	„	„ 34.. ..	2	13.84	18.8	23.5	2.3	138	1.5 : 1 : 1.5
	„	„ 35.. ..	2	14.0	17.6	24.8	5.0	135	1.5 : 1.5 : 1.5
	1 in. o.d.	„ 36.. ..	1	13.65	17.76	25.92	3.1		
	„	„ 37.. ..	1					134	1 : 1.5 : 1.5
	„	„ 38.. ..	1	12.96	17.4	26.4	23.7		
9		Specification requirements B.S.S. 1400-PB1-C				**16**	**1.5**		
	1 in. dia. × 12 in. long	Sample No. A1 ..	1			21.2	5		
	1 in. dia. × 24 in. long	„ B1 ..	1			20.8	5		
	„ „	„ B2 ..	1			20.4	5		
	„ „	„ B3 ..	1			20.0	4		
	1¼ in. dia. × 24 in. long	„ C1 ..	1¼			18.4	3½		
	„ „	„ C2 ..	1¼			17.6	3½		
	„ „	„ C3 ..	1¼			16.0	3		
	2 in. dia. × 24 in. long	„ D1 ..	2			17.6	2½		
	„ „	„ D2 ..	2			17.6	2½		
	„ „	„ D3 ..	2			17.6	2½		
	2½ in. o.d. × 1½ in. i.d. 24 in. long	„ E1 ..	⅜			18.0	4.9		
	„ „	„ E2 ..	⅜			18.8	4.9		
	„ „	„ E3 ..	⅜			17.6	4.9		
10		Specification requirements B.S.S. 1400-PB1-C				**16**	**1.5**		
	1 in. dia.	Samples cast No. 3 ..	1	9.4	12.55	20.1	7	104.4	3
	„	„ „ 4 ..	1	9.7	12.6	19.96	6.6	104.5	3
	„	„ „ 5 ..	1	10.05	12.45	18.6	4	103.9	3.5
	„	„ „ 6 ..	1	10.3	12.9	19.24	4	107	2.5

Specific gravity.	Remarks and test bar details.
	0.564 in. dia. chill cast
	" "
	" "
	All test bars in Case 8 are 0.564 in. dia.
8.52	From centre
8.57	From outside edge
8.57	Centre of casting
8.55	Outside edge casting
8.57	" "
8.50	Centre of casting
8.58	Bottom of casting
8.45	Top of casting
8.52	Bottom of casting
8.37	Top of casting
8.56	Bottom of casting—outside edge
8.58	Bottom of casting—centre
8.68	Top of casting—centre
8.68	Top of casting—outside edge
8.65	Top of casting
	Middle of casting
8.66	Bottom of casting
	Standard 0.564 in. dia. Bottom of bar
	Standard 0·564 in. dia. Bottom of bar
	Standard 0·564 in. dia. Middle of bar
	Standard 0·564 in. dia. Top of bar
	Standard 0·564 in. dia. Bottom of bar
	Standard 0·564 in. dia. Middle of bar
	Standard 0·564 in. dia. Top of bar
	Standard 0·564 in. dia. Bottom of bar
	Standard 0·564 in. dia. Middle of bar
	Standard 0·564 in. dia. Top of bar
	Standard 0·399 in. dia. Bottom of bar
	Standard 0·399 in. dia. Middle of bar
	Standard 0.399 in. dia. Top of bar
	Test bars cut from middle portions of 1 in. dia. chill cast

FIG. 5.—CASE NO. 4. SAMPLE 2. PHOSPHOR BRONZE BUSH.
CASE NO. 17. SAMPLE 6. LEADED GUNMETAL BUSH.

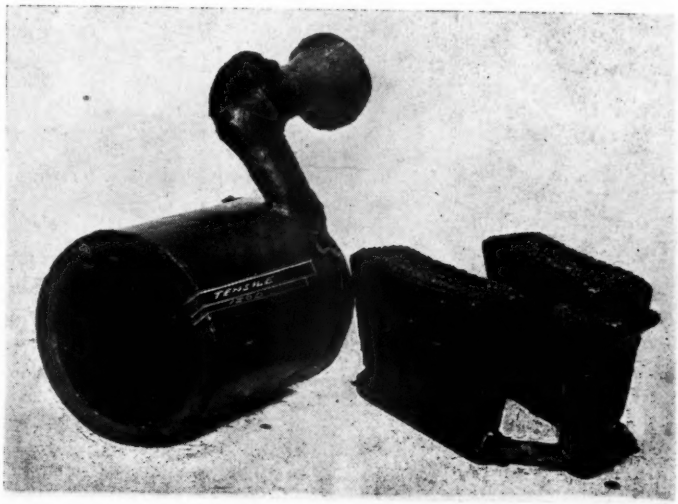


FIG. 6.—CASE NO. 4. SAMPLE 3. PHOSPHOR BRONZE BUSH.
CASE NO. 17. SAMPLE 7. LEADED GUNMETAL BUSH.

FIG. 7.—CASE NO. 4. SAMPLE 4. PHOSPHOR BRONZE HALF-BUSH. CASE NO. 17. SAMPLE 8. LEADED GUNMETAL HALF-BUSH.

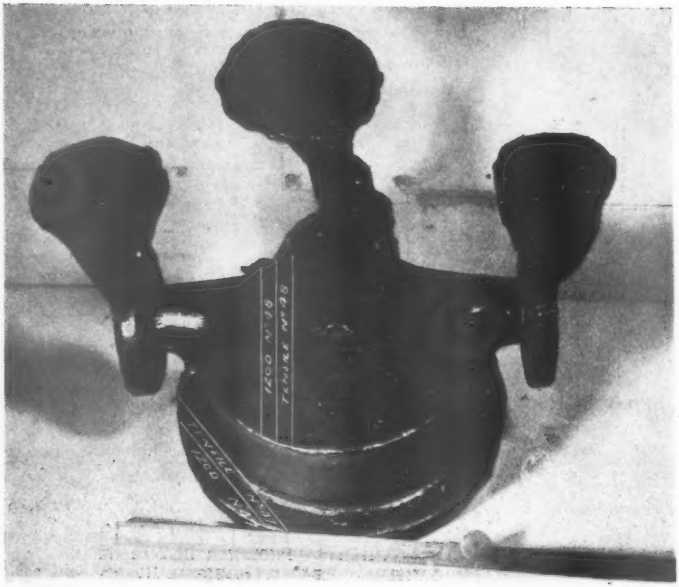


FIG. 8.—CASE NO. 5. PHOSPHOR BRONZE PUMP BODY.

Cupola Charge Materials*

Report and Recommendations of Sub-committee T.S. 27 of the Technical Council

TERMS OF REFERENCE

Sub-committee T.S. 27 was appointed:— "To prepare a report and recommendations on the best methods of utilising available materials in cupola charges."

CONSTITUTION

The Sub-committee was constituted, in May, 1948, as follows:—Mr. W. W. Braidwood (Chairman); Mr. C. R. van der Ben; Mr. H. P. Hughes; Mr. C. A. Payne, B.Sc.; Mr. S. Spray, F.I.M.; and Mr. G. Lambert (Secretary to the Committee).

Corresponding Members:—Mr. L. W. Bolton, F.I.M.; Mr. H. S. W. Brittain; Mr. W. Y. Buchanan; Mr. C. H. Kain, F.I.M.; Mr. P. A. Russell, B.Sc.; and Mr. J. J. Sheehan, B.Sc.

Introduction

This work was undertaken to implement the recommendations of Sub-committee T.S. 22. The task set was that of exploring, discussing and, where necessary, determining the best methods of making use of all of the materials which could be considered as available to the British foundry industry for inclusion in cupola charges. Since "availability" of any material might vary from area to area and even from foundry to foundry in a single area, it was necessary to study all possibilities, including materials, which might not, normally, be available to the majority of foundries. Conditions abroad are sometimes much different from those in Britain. Nevertheless, it is felt that the recommendations can be applied with advantage wherever cupolas are operated.

It was realised that the earlier the Committee's report was published the greater would be its interest and value to the industry. Accordingly, the work was carried through as rapidly as possible, fresh investigations were undertaken only where necessary and dependence was placed mainly on published information from accredited sources and the experience of committee members.

At the outset a comprehensive annotated bibliography was prepared under the supervision of Miss E. W. Parker, Technical Information Officer, the Mond Nickel Company, Limited. This was kept up to date throughout the work of the Committee, copies of original Papers were provided on request for detailed study by members of Committee and translations of foreign Papers were furnished. This co-operation on the part of the Technical Information Section, the Mond Nickel Company, was of the greatest assistance to the Committee and is warmly acknowledged.

*Presented at the Annual Meeting of the Institute of British Foundrymen, at Cheltenham, by Mr. W. W. Braidwood on behalf of the Sub-committee.

SCOPE OF THE REPORT

Cupola charge materials were studied under the following main headings:—(*a*) *Metallics*: Pig irons, cast iron scrap, steel scrap, ferro-alloys; (*b*) *Fuels*: Cokes of various qualities, anthracite coal, and (*c*) *Fluxes*: Limestone, magnesian limestone, chalk, fluorspar, etc. The report gives guidance on the variations of composition, physical condition, etc., likely to be found in these materials, and recommends methods of combating adverse effects of these variations. It also describes the techniques which are recommended for making the best use of unaccustomed or non-ideal materials. The Committee is, however, unanimously of the opinion that the greatest potential saving of cupola charge materials of all types lies in improvement of cupola operation. For that reason the Report ends with a section on the fundamentals of sound cupola practice.

METALLIC MATERIALS

Pig Irons:—At present there is still some difficulty in obtaining foundry pig irons in the quantities considered necessary by normal standards, and refined irons are generally more readily available than ordinary foundry pig irons. There is, however, greater difficulty in obtaining foundry pig irons of the normal and most desirable compositions, the most usual shortcomings being low silicon and manganese contents. The recommended methods of counteracting variations in the composition of pig irons are set out under separate headings, as follows. In each instance they are stated in order of preference.

Low-carbon.—May give rise to founding difficulties, by reason of poor fluidity and greater shrinkage, in foundries accustomed to the use of ordinary grades of foundry pig and required to charge refined iron. In such instances care should be taken to ensure that coke ratios are adequate, and the use of stool scrap should be avoided or reduced.

High-carbon:—(*a*) Blend with suitable low-carbon pig—*e.g.*, refined iron, or, (*b*) Make use of, or increase proportions of, steel scrap in the charge, adjusting silicon content as required.

Low-silicon:—(*a*) Blend with suitable higher-silicon pig iron; (*b*) Add "Silvery Pig," containing approximately 14 per cent. silicon; (*c*) Add lump ferro-silicon or silicon briquettes, (*d*) In suitable cases, *e.g.*, when the silicon difference is small and the castings to be poured are reasonably heavy, add granulated ferro-silicon or an alternative, at the cupola spout or in the ladle.

High-silicon:—(*a*) Blend with suitable lower-silicon pig iron; (*b*) Partially replace with cast iron scrap, adding manganese where and as necessary, (*c*) Use, or increase proportions of, steel scrap in the charge.

Low-manganese:—(*a*) Blend with suitable higher-manganese pig-iron; (*b*) Add speigeleisen (12 to 18 per

Cupola Charge Materials

cent. manganese; 14 per cent. normal); (*c*) Add lump ferro-manganese (80 per cent. Mn) or manganese briquettes. In charges normally containing steel scrap, manganese steel (12 to 14 per cent. Mn), or high-managanese steel (over 1 per cent. Mn) of the type commonly used in colliery tram wheels, etc., can replace ordinary mild steel and so counteract the low manganese content of the pig iron.

High-manganese:—(*a*) Blend with suitable low-manganese pig-iron, (*b*) Partially replace with cast iron scrap, adding silicon where and as necessary.

High-sulphur:—With the prevailing tendency to produce lower-silicon pig irons and the entorced use, at the present time, of higher-sulphur coke in the blast furnace, there is some increase in the average sulphur content of pig iron, though this is neither considerable, nor serious. In those instances in which use has to be made of a consignment of really high-sulphur pig it should be charged judiciously in small, uniform proportions, together with satisfactory low-sulphur pig. Manganese content should be maintained at an adequate level, by any of the methods previously listed, and limestone additions should be generous. (See section on "Fluxes.")

It is most important to ensure that the manganese content of the tapped metal is maintained at an adequate level. This should never be less than "twice the sulphur content, plus 0.3 per cent." For example, if the sulphur content is expected to be 0.15 per cent., then the charge should be such as to give a manganese content of *at least*:—

$$0.15 \times 2 + 0.30 = 0.60 \text{ per cent.}$$

In such circumstances it would, of course,: be preferable to tap with about 0.70 or 0.80 per cent. manganese.

Low-Phosphorus:—This may be a cause for complaint in light-castings foundries. (*a*) Blend suitably with a high-phosphorus pig; (*b*) Add ferro-phosphorus, in the cupola or in the ladle.

High-phosphorus:—(*a*) Blend with suitable lower-phosphorus pig, *e.g.*, semi-phosphoric, low-phosphorus or hematite pig: (*b*) Reduce proportions of miscellaneous cast iron scrap in the charge, replacing with suitable low-phosphorus pig or cast iron scrap of known low-phosphorus content; (*c*) Avoid use of stove-plate and similar thin-section scrap, which is virtually certain to be phosphoric, replacing with general engineering type scrap or scrap of known low-phosphorus content; (*d*) Use or increase proportions of steel scrap in the charge.

Size of Individual Pigs

The Committee is unanimously of the opinion that it would be to the advantage of the foundry industry if pig-iron producers would prepare pigs smaller than those in general use. This is particularly so in the case of machine-cast pigs, the larger pigs in this class being too heavy for ease of handling or for breaking to preferred size and too massive for efficient melting in cupolas of diameters less than 48 in. For these reasons the recent trend towards the production of machine-cast pigs in narrower and shallower moulds is welcomed. Some guidance on recommended sizes of materials to suit cupolas of various diameters is given in Table I (page 4).

Machine-cast or Sand-cast Pigs

Generally speaking, no difficulties should be experienced with changes from sand-cast pig to machine-cast pig, or vice versa. There may be cases, however, in which slight alterations in cupola operation may be necessary, but these should be easy to apply when the reasons are appreciated. For instance, in a large cupola where whole or half sand-cast pigs are normally used, complete change-over to machine-cast pig will result in a more densely packed charge. On the other hand, quarter pigs of sand-cast iron, if normally used in a small cupola, may give denser charging than machine-cast pigs. It is suggested, therefore, that the physical nature of the cupola charge as a whole be considered when a change from normal supplies has to be made and the operation of the cupola modified accordingly.

Another point which should not be overlooked in connection with size of materials is that weighing should be accurately maintained. Charging by volume or visual estimation can result in variations in the iron/coke ratio which can cause trouble, especially if the ratio is near the minimum. Again, there may be reasons for maintaining a particular fluidity and volume of slag in certain cases. As sand-cast pigs produce more slag than machine-cast pigs, the flux addition may require modification and the charging of cupola slag, in order to maintain standard conditions, may be desirable in suitable cases. Alternatively, additions of silica may be made, as described later.

Where the characteristics of sand-cast pig are judged by fracture, possible difficulties with the use of machine-cast pig can be avoided by adopting a control based on the carbon equivalent of the mixture. In order to apply this, the operator must know the carbon balance of the normal irons made from charges containing sand-cast pig. It is not possible to lay down precise recommendations, as such carbon balance will obviously vary for different jobs, but the committee is aware of instances in which this procedure is practised, fracture being completely ignored with satisfactory result. It may be mentioned that this method of mixture control is particularly helpful when inconsistent supplies of all materials are being received, as one variable, metal composition, is eliminated.

Proportions of Pig-iron Charged

Ordinary Grey Irons.—In normal cupola practice, pig-iron is used in proportions of from about 30 to about 70 per cent. of the charge. The pig-iron component of the charge provides metal, of course, but it also functions to ensure that required properties and compositions shall be obtained in the resultant cast iron. From the point of view of composition the most

important purpose served by the pig-iron is provision of silicon and manganese, though its effect on carbon and phosphorus contents may also be of consequence. By the use of relatively small quantities of ferro-silicon and ferro-manganese or alternatives, together with further replacement of pig-iron by cast-iron or steel scrap, it is possible to maintain composition within workable ranges with less-than-normal proportions of pig-iron.

Similarly, in foundries which experience acute shortage of foundry pig-iron, while supplies of cast-iron scrap are adequate, use can be made of charges containing about 80 per cent. scrap, the balance of the charge consisting entirely or substantially of high-silicon, high-manganese pig containing silicon 4 to 5 per cent. and manganese over 1 per cent. Successful use of charges of this type is reported from several foundries.

In extreme cases, *e.g.*, when stocks of pig-iron are exhausted, while cast-iron scrap is available, use may be made, for production of ordinary grades of grey cast iron, of pig-free charges containing silicon and manganese in the form of ferro-alloys. Such charges should be composed somewhat as follows:—

Purchased cast-iron scrap ...	75 to 50 per cent.
Own returned cast-iron scrap	25 to 50 per cent.
plus	
Ferro-silicon	
(45 per cent. Si)	14 to 28 lb. per ton of total charge.
(80 per cent. Si)	8 to 16 lb. per ton of total charge.
and	
Ferro-manganese (app. 80 per cent. Mn)	5 to 10 lb. per ton of total charge.
or	
Speigeleisen (app. 14 per cent. Mn)	28 to 56 lb. per ton of total charge.

When use is made of charges of the unconventional types detailed there is a tendency for carbon content to be lowered and sulphur to be increased, both conditions having the effect of increasing shrinkage, with the result that founding difficulties due to sinks, draws and hard sections are liable to arise. To aid in combating this tendency, adoption of the following technique is advised:—

Increase the normal coke charge by 10 per cent.

Increase the normal limestone charge by 25 per cent.

Make suitable additions of a graphitising nature (*e.g.*, ferro-silicon or other silicon-containing material, powdered graphite, etc.) to the metal in the spout or in the ladle.

Give careful attention to gating and feeding methods.

Desulphurise where practicable—e.g., by addition of soda ash to the metal in a suitable receiver or tea-pot ladle.

In such circumstances, the maximum use should always be made of the foundry's own scrap. The Committee emphasises that the use of pig-free charges should be regarded as an emergency procedure only. It is not considered to be a fully satisfactory substitute for conventional technique using pig-bearing charges.

High-duty Cast Irons.—The normal practice is to include steel scrap in the charge in proportions which tend to increase the higher the tensile-strength requirement. Guidance on charge make-up is given in Table III in the section on steel scrap.

Cupola-melted Iron for Converters

Shortage of suitable pig iron for cupolas feeding side-blown converters is a problem likely to continue for some time. The chief shortage is of high-silicon hematite pig, and this leads to the use of higher proportions than necessary of the lower-silicon pig available, or additions of ferro-silicon to the cupola charge or the converter. In pre-war practice the cupola charge comprised 25 to 50 per cent. of hematite pig, according to silicon content, with the remainder steel scrap. Normal variations in the composition of the metal tapped from the cupola were:—Carbon, 2.5 to 4.0; silicon, 0.8 to 2.5, and manganese, 0.4 to 0.9 per cent. Additions of ferro-silicon to the converter were made, when necessary, to compensate for low temperature or for low silicon or low carbon content in the tapped metal. Silicon additions of this type were as high as the equivalent of 1 per cent. silicon.

During the war years research showed that low-silicon iron could be blown successfully provided that carbon was in excess of 3 per cent. and that the metal was sufficiently hot. The necessary high temperature can be obtained from well-designed cupolas efficiently run or, where necessary, by superheating in a separate furnace. Recommendations for economy in hematite iron fall, therefore, under three headings:—(1) The cupolas should have a high bed and a deep well, to facilitate carbon pick-up; (2) the cupola should be operated with good control of coke and air, to give high metal temperature, and (3) arrangements should be such as to give minimum delay between tapping from the cupola and pouring into the converter. With these recommendations observed it is possible to run regularly and satisfactorily with over 70 per cent. of steel in the cupola charge.

Operators of converters are well aware of desulphurising methods and these should be checked regularly if increased quantities of steel scrap are used and if hotter metal is obtained, as both of these factors may cause the sulphur in the cupola to be higher. Recommendations are made later in this Report with regard to desulphurisation, and the double-pouring technique, when properly carried out, will effect a sulphur reduction of around 70 per cent. from the use of 25 to 30 lb. of soda ash per ton of metal treated. It should be borne in mind, however, that the second teeming may result in an additional temperature drop of between 20 and 50 deg. C., depending on the temperature of the ladles used.

Cast-iron and Steel Scrap

These materials are particularly scarce at present, and over the past several years this shortage has inspired a nation-wide appeal for collection of ferrous scrap. This appeal has recently been strongly revived. Foundries and engineering works can themselves do much to ease the situation which affects them so acutely. There are few foundries which do not retain

Cupola Charge Materials

moulding boxes of the out-of-date or "might-possibly-be-wanted" categories, antiquated, redundant or broken tackle, obsolete castings and "not-likely-ever-to-be-used-again" metal patterns, besides odds and ends of derelict machinery and the weird collections of "bits-and-bobs"—useless clamps, lengths of wrought iron and steel bar, and even pigs of the good, old-fashioned variety, which so often are among the oldest inhabitants. In most cases a thorough clean-up of the foundry or engineering shop will yield a bumper harvest.

Preparation and Segregation

These are matters of great importance, and the provision of proper facilities for carrying out these operations is usually well worth while. Preparation includes dismantling, breaking and cutting to size, and such other procedures as briquetting and canistering of swarf, etc. These operations are all necessary if the most efficient use is to be made of the widest range of materials. Guidance on ideal sizes is given in Table I, and in the section on steel scrap.

Segregation involves considerations of size, weight and condition, as well as type and composition. Efficient segregation ensures proper use of good materials and best possible use of poorer grades. It also avoids usage of materials which are quite unsuitable. It is an art which is mainly the product of experience and which cannot be taught by words. Nevertheless, the following paragraphs may give some useful guidance.

Rusty or Scaled Scrap.—Iron or steel scrap which has a heavy coating of rust or scale is undesirable and should be directed to the blast furnace wherever practicable. If use must be made of such material in cupola charges, the following precautions should be observed:—

(*a*) Work with a softer blast; (*b*) increase the coke ratio; (*c*) increase the limestone addition, and (*d*) in very bad cases it is advisable to pre-melt the scrap to pig for subsequent re-melting. (This procedure is recommended also in extreme instances in which there is available only very mixed scrap, thought to include unsuitable types. The disadvantages of pre-melting are that additional fuel is used, that silicon and manganese losses occur, and that sulphur is increased. The losses can be made good by additions of silicon and manganese and desulphurisation of the molten metal by soda ash is recommended.)

Enamelled Scrap.—Since enamels consist mainly of metallic oxides, which are difficult to reduce but easy to remove in the slag, use can be made of enamelled scrap with safety. It is preferable, however, to use such scrap judiciously, by including in it small, uniform proportions in each charge, while increasing the amount of flux as required to keep the slag condition satisfactory.

Consideration of Size

Size limitations have been quoted in Table I. Overweight pieces should be charged only at intervals

TABLE I.—*Raw Material Sizes for Normal Cupola Charges.*

Cupola dia., in.	24	30	36	48	60	72
Cupola area, sq. in.	452	708	1,018	1,810	2,827	4,072
Coke:						
Wt. of split,* lb.	45	70	100	180	280	400
Preferred size, in.	2–5	2–6	3–6	3–8	4–8	4–10
Metal Charge Pieces:						
Greatest dimension, in.:						
Preferred	8	10	12	17	22	26
Maximum	10	13	18	24	30	36
Maximum area of flat pieces, sq. in.:						
Cast iron, pig, etc.	50	80	110	190	260	350
Steel scrap	40	60	85	150	210	300
Maximum weight of individual pieces, lb.	40	60	90	170	220	270

* Based on an established average apparent density of 28 lb. of coke per cub. ft.

Notes:—

(1) Greatest dimension is usually length, or diagonal of flat pieces.

(2) *Maximum area of flat pieces.*—Flat pieces are best defined as those in which the thickness is under 1 in. or less than 1/12 of the greatest dimension. The area is that area of the cupola cross-section occupied by the piece when lying flat in the stack. Where the charge contains more than the odd piece of flat material it must be borne in mind that the total area of flat surfaces will be very much greater than that of any given piece, and the size should be controlled accordingly, *i.e.*, all pieces should be well below the maximum, especially with steel scrap.

(3) *Maximum weight of single pieces.*—In hand charging this is normally governed by the weight which men can lift and throw in. The weights given are to be considered the maximum for the largest piece in any normal charge. Where a number of large pieces must be used per charge, the maximum size of piece permitted should be reduced. For pieces above the normal maximum the preferred practice is to charge 1/10 of the weight of the piece in extra coke, immediately under the piece.

(4) *Minimum sizes.*—For cast iron the minimum size of piece is governed by the size of coke used out, generally speaking, a small percentage of pieces of size similar to the limestone used will not cause any difficulties. With steel scrap, however, section thicknesses below ¾ in. or weights below about 1 to 2 lb. are not advisable without modified techniques. As the size of the furnace increases, so the minimum weight should be increased.

(5) It can be assumed that scrap materials can be considered normal in size if not more than 5 per cent. of the pieces are outside the limits given above. Where this proportion is exceeded, the particular consignment should be mixed with at least an equal weight of normal material, or the out-of-size proportion segregated and used with special attention.

(6) For the bed, selected uniformly sized coke should be used, and the weights of initially charged pieces kept well below the maximum, to reduce as far as possible the effects of dropping the charge materials from the sill on to the coke bed.

throughout the melt, and should be placed near the wall of the cupola and on top of a generous coke layer, as stated. They should not be charged during the initial filling of the cupola, but at any time subsequently, preferably towards the end of the melt but before the last few charges. Where it is necessary to use over-long material this should be charged with care, radially, or placed on end in the cupola.

Very light scrap should be placed on the top of each charge. When predominantly light-section scrap is used in fan-blown cupolas the airflow is usually increased, and where a flow meter is in operation, the necessary adjustment should be made to ensure the normal rate of flow. Where no meter is available, the valve setting should be somewhat reduced. It is advantageous to increase the proportion of flux charged, but no substantial increase in loss of oxidisable elements is encountered when melting light-section scrap.

"Flash," pellets, sprigs and tramp iron.—Can be utilised by any of the following methods:—(*a*) Collect regularly and add in small amounts at a time to the cupola charges, but not to the charges used for initial filling of the furnace; (*b*) accumulate the materials and melt them subsequent to the blow-down, pigging for later incorporation in the cupola charges, and (*c*) by any of the alternative methods later detailed for disposal of swarf.

Identification.—It is of advantage to be able to make a reliable estimate of the composition of the cast iron and steel scrap in use. To assist in this matter some important, readily-identifiable types of scrap are described.

Cast Irons

Light-section scrap.—This is usually in the form of stove plate and rainwater castings. It is almost always in ¼-in. or thinner sections and the normal composition is:—Carbon, about 3½; silicon, 2½ to 3; phosphorus, 1½ to 1¾ per cent.

Machinery Scrap.—Generally up to 1½ in. in average section, and recognisable, even in the broken condition, by its machined surfaces and general appearance. Average composition is usually approximately as follows:—Carbon, 3½; silicon, 1½; manganese, ½ to ¾; phosphorus, ¾ to 1.0, and sulphur, 0.1 to 0.13 per cent.

Heavy-engineering scrap.—Greater than 1½ in. in average section and usually of fairly low silicon and medium phosphorus content. No reliable average composition can be quoted, though the following wide range generally applies:—Carbon, 3 to 3½; silicon, 1 to 2, and phosphorus, 0.4 to 1.0 per cent.

Railway chairs.—Scrap of this type is readily identifiable, with composition normally in the range:—Carbon, 3 to 3¼; silicon, 1¾ to 2¼; manganese, usually ½ per cent. or lower; phosphorus, 1 to 1½. The physical form of this type of scrap is very satisfactory, but, due to its occasional high sulphur and low manganese contents, it is advisable, in the general engineering foundry, to arrange for judicious charging in regular proportions, normally not greater than 30 per cent. of the charge, while taking appropriate steps to ensure that the tapped metal contains manganese in excess of 0.7 per cent. In foundries required to produce grey-iron castings of very light section, its use should be further restricted or avoided altogether.

Automobile-engine scrap.—This type of scrap, readily identifiable by appearance, is often received in the form of complete engines, containing steel components, *e.g.*, camshafts and crankshafts, usually alloyed. It is preferable that such units be broken up to separate the cast iron from the steel scrap. The cast-iron scrap will usually have a base composition approximately as follows:—Carbon, 3½; silicon, 2 to 2½; manganese, ½ to ¾; sulphur, 0.08 to 0.10, and phosphorus, 0.2 to 0.6 per cent. Where engine units must be charged complete, it is necessary to allow for the fact that they contain steel and the charge should be modified accordingly, by reduction in the proportion of steel scrap usually charged, or by increase in the silicon content of the charge. Use of composite scrap of this type is not recommended in the case of foundries producing castings of very light section.

The steel components, usually crankshaft, camshaft, connecting rod, timing gears, valves and valve springs, studs, bolts and chain, normally represent between 20 and 30 per cent. of the mass, a fairly reliable average being 25 per cent. In those instances, therefore, in which it is necessary to charge entire engines to cupolas of suitably large diameter, the charge calculation should be made on the understanding that one-quarter of the total weight of each engine consists of steel. Non-ferrous items such as aluminium pistons, white-metal bearings, copper or brass tube, etc., are also normally present, and though these may not give trouble in cupola-melted metal, their recovery value is a strong argument in favour of prior dis-assembly.

Ingot-mould scrap.—Recognisable by its flat, parallel surfaces, usually "crazed," and its uniform section thickness of from 2 to 5 in. Average composition may reliably be accepted as:—Carbon, 3½; silicon, 1½; manganese, ½ to 1; sulphur, 0.08, and phosphorus, 0.15 per cent., max.

Austenitic cast iron.—This can readily be identified by the fact that it gives no response to a magnet. Where materials are handled by magnetic methods, this is a ready means of identification and segregation. Austenitic cast irons will contain nickel, probably copper and chromium also, and may have high manganese or high silicon content. Where laboratory facilities are available, and special cast irons are being produced, austenitic cast-iron scrap should be analysed and remelted in special charges so that its alloy contents may be utilised as fully as possible, with consequent saving in virgin alloys. Where laboratory facilities do not exist, such scrap should be used in a very cautious manner. In no instance should more than 5 per cent. of the charge be composed of non-magnetic cast-iron scrap. In foundries producing grey-iron castings of light section no use should be made of such material.

White cast iron.—White cast iron can be identified by its relatively low resistance to shock, and by its characteristic white fracture. It usually contains less than 1 per cent. silicon, and its sulphur content may be in excess of 0.15 per cent. It may contain alloys, particularly nickel and chromium, and careful usage is recommended. It can be used to replace steel scrap in the charge,

Cupola Charge Materials

preferably in small amounts. Where facilities exist for analysis, it is recommended that a check be made on the composition of each consignment of white iron and subsequent usage be planned accordingly.

Malleable Cast Iron

Scrap of this general type can be identified by its ability to deform under a blow and by the appearance of its fracture. Segregation of the individual types is, however, essential for efficient utilisation. Fairly complete guidance is given below.

Blackheart.—The fracture, when viewed vertically, is a dull black, but when the sample is inclined and viewed obliquely, the appearance assumes a silky sheen and is lighter in colour. Usually there is a thin dull grey edge

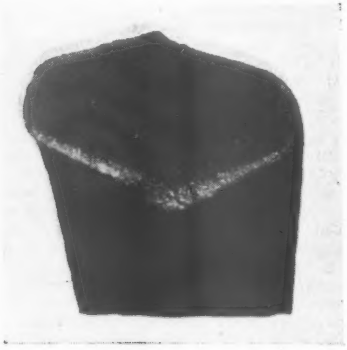


FIG. 1.—TYPICAL FRACTURE OF BLACKHEART MALLEABLE CAST IRON.

surrounding the fracture, due to incidental surface decarburisation during annealing. When broken transversely, the compression side of the fracture will show a bright, fine-grained, steely appearance, merging into the normal black fracture on the neutral axis and the tension side. A typical fracture is shown in Fig. 1.

Typical percentage composition ranges are:—

Blackheart best quality.

	Per cent.
Total Carbon	2.2 to 2.7
Silicon	0.8 to 1.1
Manganese	0.30 to 0.45
Phosphorus	0.06 to 0.08
Sulphur	0.07 to 0.15

Cupola-melted Blackheart. Usually exclusive to pipe fittings.

	Per cent.
Total Carbon	2.8 to 3.1
Silicon	0.06 to 0.08
Manganese	0.4 to 0.6
Phosphorus	0.6 to 0.8
Sulphur	0.15 to 0.25

Blackheart malleable cast-iron scrap may be used, in proportions not exceeding 15 per cent. of the total charge, to replace grey-iron scrap. Compensating additions of silicon and manganese should be made.

Whiteheart.—In the case of this material, fracture varies with section thickness. In very thin castings, say about $\frac{3}{16}$ in thick, in which there exists little or no graphitic carbon, the appearance is a dull grey and fine grained. In medium and heavy sections, say $\frac{1}{2}$ in. and greater, in which graphitic carbon is almost always present, the edge is dull grey, but the core is bright, coarse-grained and steely, and usually there is a distinct annular ring of coarser grain. When broken transversely, the compression side of the fracture will show some bright, steely areas. A typical fracture is shown in Fig. 2.

The normal range of composition is:—

	Per cent.
Total Carbon	0.2 to 2.50
(Highest in heavy sections).	
Silicon	0.3 to 0.8
(Lowest in heavy sections).	
Manganese	0.2 to 0.3
Phosphorus	0.06 to 0.08
Sulphur	0.15 to 0.25

Whiteheart malleable cast-iron scrap may be used, in proportions not exceeding 10 per cent. of the total charge, to replace grey-iron scrap. Compensating additions of silicon and manganese should be made. It may be used in proportions up to 20 per cent. of the total charge as partial replacement for steel scrap.

Steel

Identification of separate types of steel scrap is neither so easy nor so sure as with cast-iron scrap, and analysis is usually necessary. Magnetic response, resistance to rusting, and shape do, however, give indications, as follow:—

Non-Magnetic Steels

Manganese steel: This is not particularly resistant to corrosion and will be very difficult to drill. It usually contains about 14 per cent. manganese and, in suitable instances, can be used to provide manganese.

Stainless Steels

These are markedly resistant to rusting. Usually they contain 18 per cent. chromium, with 8 per cent. nickel, but chromium can be as high as 25 per cent. and nickel can range up to 35 per cent. Molybdenum may also be present in amounts up to 4 per cent. Castings will always be non-magnetic, but wrought parts may give some response as a result of cold-work. Where the composition is known or established, the scrap can be used to fullest advantage. Otherwise, it should be used in very small proportions.

Magnetic Steels

Stainless.—These respond to a magnet, though they are relatively rust-resistant. They contain chromium, usually 12 to 18 per cent., but possibly as high as 30 per cent. They can be used with advantage in suitable instances to provide chromium. Otherwise, the

material should be used in proportions not greater than 1 per cent. of the total charge.

Spring steels.—Recognisable by shape, but compositions may vary widely. Usually such material contains 1.5 to 2.0 per cent. silicon, but some types of car springs are made of carbon steel or 1 per cent. chromium steel.

Tool steels.—Recognisable by shape. All contain tungsten, usually in the range 14 to 22 per cent., but lower-alloy types, *e.g.*, 6 per cent. tungsten, 6 per cent. molybdenum, are in use. Wherever possible, such scrap should be made available to suppliers of tool steels.

Steels of the normal low-alloy compositions, such as nickel, nickel-chromium, nickel-molybdenum, and nickel-chromium-molybdenum types, may be used in reasonable proportions with good results. Chromium and chrome-molybdenum steels, however, may give trouble if used without suitable precautions, such as adjustment of base composition. Chromium steels of the armour-piercing type, which contain up to 5 per cent. of chromium are liable to give really serious trouble if used in other than very small proportions. For that reason, it is always wise to do check analyses of consignments of bomb or shell scrap. Further aids to identification of cast iron and steel scrap and non-ferrous metals, by blow-pipe, spark and spot tests are described in the literature (G.4).

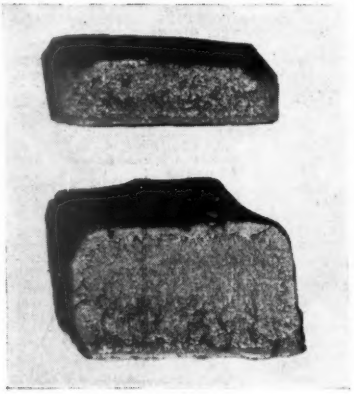


FIG. 2.—FRACTURES OF WHITEHEART MALLEABLE CAST IRON.

Steel Scrap—Influence of Size and Condition

The use of light-section steel scrap which has a high ratio of surface area to mass is liable to promote severe oxidation, and the presence of rust or scale on the scrap increases this tendency. Such material should be directed to the blast furnace or the open-hearth furnace. So also should baled scrap. On the other hand, the use of steel scrap in massive sections, *e.g.*, billet ends and heavy bar croppings with a low ratio of surface area to mass, tends to give trouble because of the time taken to effect complete melting, the normal result being the appearance of solid metal in the cool zone just above the tuyeres. Massive scrap is best used in open-hearth furnaces. For best results in the cupola, a surface area to mass relationship of from 10 to 20 sq. in. per lb. weight is recommended. The charging of unduly long pieces of steel scrap involves risk of "scaffolding," while the charging of flat pieces of large area tends to reduce the rate of air flow through the stock.

For all the above reasons, the following brief general specification may be applied:—"Steel scrap for use in cupola charges should be reasonably free from rust and scale, not under ¼ in. nor over 3 in. thick, with no piece longer than one-half the diameter of the cupola nor of area greater than one-twelfth that of the cupola cross-section." Mild-steel punchings are suitable for inclusion in cupola charges only when they are of relatively large diameter, say 3 in. and more. Such material should not be used in proportions greater than one-third of the weight of steel charged. Smaller punchings should preferably be melted in crucible, rotary, electric or open-hearth furnaces. Wire rope is often available. When made up into neat coils and securely bound with heavy wire, this material can be used quite satisfactorily. The coils should be charged flat in the centre of the cupola.

(*To be continued.*)

(*Continued from page 8.*)

TRAINING IN FRENCH FOUNDRIES

V. Preparation au C.A.P. de Mouleur Noyauteur. (Formation complète dans les Centres d'Apprentissage.) (Study Course for Apprentices trained in Schools.)

VI. Preparation au C.A.P. de Mouleur Noyateur. (Formation pratique dans les Fonderies. Formation théorique dans les Cours Professionnels collectifs.) (Study Course for Apprentices trained by part-time release.)

VII. Preparation au C.A.P. de Mouleur Noyauteur. (Formation complète dans les écoles d'usines.) (Study Course for Works Schools.)

VIII. Contrat d'Apprentissage. (Apprenticeship Indentures.)

IX. La Formation des Techniciens et des Ouvriers Superieurement Qualifies. (Training of Technicians and highly-skilled Craftsmen.)

IX (*b*). Formation des Techniciens et du Personnel Hautement Qualifie. (Formation complète dans les Collèges Techniques.) (Technical School Training for highly-skilled Craftsmen.)

X. La Formation de la Maitrise. (Foremanship Training.)

XI. Preparation au Brevet Professionnel Formation de la Maitrise (Certification of Foremen.)

XII. Profil de l'Agent de Maitrise de Fonderie. (Psychological Examination System Used.)

XII (*b*). Conclusions d'un Examen Psychotechnique. (Actual copy of a Result of an Examination.)

XIII. Les Organismes d'Apprentissage et Leurs Actions dans la Formation Professionnelle du Personnel de la Fonderie. (The Co-ordination of Educational Activities in France.)

XIV. L'Unification de l'Apprentissage. (List of Published Books for the Study of Foundry Practice.)

A. Certificat d'Aptitude Professionnelle C.A.P. Texte des Epreuves imposées, 1948. (Trade Proficiency Certificate—Text of the Tests Imposed, 1948.)

B. Livret Professionnel. (Tradesman's Diploma.)

C. Formation Pratique. (Practical Training.)

D. Photographies de quelques modèles utilises pour les epreuvet du C.A.P. (Photographs of Some Patterns used in the National Examination.)

E. Technologie. (Technology.)

F. Cours de Dessin. (Design Course.)

G and J. Formations Cadres Moyens et Cadres Supérieurs. (Training Averages and Good Groups.)—

K. Formation Professionnelle accélerée. (Up-grading.)

Personal

MR. J. B. DOBSON has taken over the duties previously exercised by MR. J. B. WINDSOR-RICHARDS at the Ministry of Supply.

MAJOR JACKSON MILLAR has been appointed a director of the Crittall Manufacturing Company, Limited, manufacturers of metal windows, brassfounders, of Braintree, Essex.

MR. JAMES AITKEN, a director of Hendry Bros., Limited, engineers and manufacturers' agents, etc., of Glasgow, has retired from business after nearly 50 years' service with the firm.

LT.-GEN. SIR WILFRED G. LINDSELL has resigned from the boards of the National Gas & Oil Engine Company, Limited, Ashton-under-Lyne, Lancs, and Smart & Brown (Engineers), Limited, Bingley, Yorks, owing to pressure of other business.

M. CLAUDE FREDERIC ARMAND SCHAEFFER, formerly Director of Research at the National Centre of Scientific Research in Paris, has received the honorary degree of Doctor of Law from Glasgow University. He is a well-known archæologist.

MR. W. H. DARLINGTON, of the condenser engineering department of the Metropolitan-Vickers Electrical Company, Limited, has been awarded the degree of Doctor of Philosophy in the Faculty of Engineering at the University of London.

MR. C. N. R. AAMUNDSEN, managing director of Akers mek. Verksted, Oslo, a well-known shipbuilder, has had the honorary degree of LL.D. conferred upon him by Glasgow University. He gained his degree of B.Sc.(Eng.) at Glasgow in 1920.

PROF. SIR ALFRED EGERTON, F.R.S., head of the Department of Chemical Engineering and Applied Chemistry at the Imperial College of Science and Technology, has been appointed Director of the Salters' Institute of Industrial Chemistry in succession to the late Sir Robert Robertson, F.R.S.

MR. R. MCGILL, foreman of "H" department of Glenfield & Kennedy, Limited, hydraulic engineers and foundrymen, of Kilmarnock, has received the company's long-service medal to mark the completion of 50 years' continuous service. He was the 80th recipient of the medal, which was instituted in 1931. Of the 80, eight are still in service with the company.

SIR PHILIP WIGHAM RICHARDSON'S resignation from the chairmanship of Swan, Hunter & Wigham Richardson, Limited, ship builders and repairers, etc., of Wallsend, has been accepted by the board. The resignation dates from December 31, 1949. Sir Philip, who is 84, will be succeeded by MR. JOHN W. ELLIOTT, the vice-chairman, who has been with the company since 1903.

SIR RALPH GLYN, Bt., M.P., is one of five additional members to be appointed by the Secretary of State for the Colonies to serve on the Colonial Economic and Development Council. Sir Ralph is chairman of the Skefko Ball Bearing Company, Limited, Luton, and a director of J. Samuel White & Company, Limited, shipbuilders, etc., of Cowes, Isle of Wight, and other companies.

SIR MAURICE EDWARD DENNY, Bt., chairman of William Denny & Bros., Limited, shipbuilders and engineers, of Dumbarton, has received the honorary degree of Doctor of Law from Glasgow University. Sir Maurice is an advocate of academic attainments in business. His firm has awarded numerous scholarships in naval architecture and marine engineering. A similar honour was conferred upon his father and grandfather.

Wills

EAGLETON, J. H., late director of Monkbridge Iron & Steel Works, Leeds £4,524

DAVIS, C. T., of Torquay, late engineer, trading as the Automatic Machine Company £7,265

KAYE, D. H., head of Miles Kaye & Son, metal and machinery merchants, etc., of Dewsbury £14,903

GARSDEN, J. W., manager of the Manchester branch of the Edison Swan Electric Company, Limited ... £11,463

PEGG, E. J., a director of Pegrex, Limited, press workers and press-tool manufacturers, of Birmingham £40,873

MAYER, R. G., managing director of Thos. Mayer & Company, Limited, bolt and nut manufacturers, of Darlaston £66,076

MCDONALD, JAMES, late managing director of David McDonald & Son, Limited, steel-barrow manufacturers, of Glasgow £9,411

SNAGGE, SIR HAROLD E., late chairman of D. Napier & Son, Limited, aero-engine manufacturers, and a director of other companies £20,003

GREENHALGH, NATHANIEL, a director of Burton, Griffiths & Company, Limited, engineers' machinery and small-tool merchants, of Birmingham £13,708

THOMPSON, S. L., a director of Joseph L. Thompson & Sons, Limited, and John Crown & Sons, Limited, shipbuilders, of Sunderland, and many other companies £141,850

DORRINGTON, WALTER, a director, and late managing director, of E. C. & J. Keay, Limited, structural engineers and bridge builders, of Birmingham and Darlaston; a director of Iron & General Investments, Limited; a member of the Institution of Structural Engineers, and of the Iron and Steel Institute £36,989

Engineers' Wages

The national committee of the Amalgamated Engineering Union decided at its conference at Scarborough to ask the Confederation of Shipbuilding and Engineering Unions (of which the A.E.U. is a member) to make immediate application for a wage increase of £1 a week for all workers in the two industries. It was specified that the increase should be met from profits and not added to the price of consumer goods. The figure of £1 was adopted by amendment as being more realistic than that of £2 in the original motion.

At a subsequent meeting the committee decided to present immediately a claim for a wage increase of £1 a week on behalf of about 100,000 workers in Government establishments.

AT THE LABORATORIES of the British Non-ferrous Metals Research Association, which, following the annual general meeting, were inspected last week by members, there were shown in the foundry special high-speed temperature recorders for researches on the production of sand castings. Fundamental studies are being made of the heat flow in non-ferrous castings during solidification and of grain refinement of aluminium and other metals.

Institute of British Foundrymen

London Branch, Annual General Meeting

A New Foundry Film

The Annual General Meeting of the London Branch was held at the Waldorf Hotel, Aldwych, on April 27, Mr. P. D. Pincott (Branch-President) presiding.

Apologies for absence were received from Mr. D. Graham Bissett, Sir William Griffiths, Dr. D. H. Ingall, and Mr. G. W. Bush. The minutes of the preceding Annual General Meeting were taken as read and were confirmed and signed.

Accounts.—The Hon. Secretary and Treasurer (Mr. F. Arnold Wilson) presented the accounts for the year 1948 and said the figures for the last four years' accounts, *i.e.*, the total expenditure of the London Branch, were as follows:—1945, £126; 1946, £163; 1947, £173; and 1948, £176. Against this, the Subscription Account again showed a large increase:—In 1945 subscriptions totalled £871; in 1946, £1,218; in 1947, £1,483; and in 1948, £1,568.

This figure of £1,568 was a new record for any branch of the Institute and it was interesting to compare the 1948 figure with that of 1938 when subscriptions totalled £490, or in other words, less than one-third of the 1948 subscription total. Whereas in 1938 the expenses of the London Branch represented 20 per cent. of the subscription total, the corresponding figure for 1948 was down to 11 per cent. of the subscription total.

He proposed the adoption of the accounts, which proposal was seconded by Mr. V. Delport and approved unanimously by the meeting.

Secretary's Report

The Hon. Secretary presented his report for the year 1948/49, from which the following excerpts are made:

In presenting his fourth report as Hon. Secretary of this branch, Mr. Wilson said he was pleased to say that London was still forging ahead and was still the largest branch of the Institute of British Foundrymen.

Membership.—Last year the then record figure which was calculated at 638, took into account a number of names which were due to be struck off owing to non-payment of subscription, which actually were not operative until the year under review. Starting from the official figure in the Institute's Report for the London Branch of 656 at April 30 last year, the total now was 712, namely, a net increase of 56 members. The following figures showing the turnover of membership for the Branch may be of interest to members. They were as follows:—

Increases:

New Members elected	75
Additions on account of Subscribing Firm representatives now being counted as Members ...	27
Transfers from other Branches ...	9
	111

Decreases:

Transfers from London Branch to other Branches	11
Deaths	4
Resignations	10
Struck off	30
	55
Thus giving a net increase of	56

Honours.—Members had greatly admired the most competent way in which Mr. R. B. Templeton, past-President of this branch, had carried through his many and varied duties as President of the Institute and he felt that he had raised the prestige of the Institute to a higher level than ever reached before. Members were all very pleased that Mr. J. R. Coates, President of the Ipswich Section, was awarded a diploma by the Institute for his excellent Paper on "Foundry Conditions, Personnel and Production," which he presented to the London Branch on November 26, 1947, and he again offered him his warmest congratulations.

Branch President.—There had again been a first-class session, with an average attendance of 104 members and visitors at each meeting, and he felt that their warmest thanks were due to their President, Mr. P. D. Pincott, who had steered the ship so successfully in the past year.

The Year's Work.—This really started with the Annual Conference of the Institute in London, and many hours were spent by the office-bearers, past-Presidents and Council on what was really a very big task, but the success of this Conference under the Presidency of Mr. R. B. Templeton was quite outstanding, and it was the biggest Conference which the Institute had ever held. Every Member of the London Branch connected with it pulled his weight, and it was particularly gratifying to have such an ample squad of Stewards to help at the various functions. The ladies, from Mrs. R. B. Templeton downwards, all worked extremely hard, and they also deserved much praise.

The September Meeting was well attended. It was a works visit to John Every & Son (Lewes), Limited's, Works, followed by tea provided by John Every's before returning to London. Both their foundries were thrown open to the minutest inspection, and Mr. Oldershaw, who organised the visit, was delighted with the stream of questions with which he was plied during the afternoon.

At the October Meeting, the Branch President, Mr. P. D. Pincott, delivered his Presidential Address, which was extremely well received. This was followed by Mr. C. R. Van de Ben's Paper and film on "Production of Castings for Internal Combustion Engines," which rounded-off a most successful evening.

Annual General Meeting

The November Meeting was an open discussion on "Is Foundry Mechanisation Worth While?" opened by Mr. John Gardom, past-President of the Institute and of the Branch. At this Meeting he felt that there was not the same vigour about the discussion as might have been expected, but, possibly, members were overawed by Mr. John Gardom's great experience on this subject.

At the December Meeting, at which the members were the guests of the Institute of Metals, Dr. Scheuer presented his Paper and slides on "The Solidification of Metals, with special reference to Continuous Casting Processes," and this Meeting, as is usual with these joint meetings with the Institute of Metals, provided a most interesting evening.

On December 17 was held the Annual Dinner and Dance at the Café Royal, and in addition to the National President and Mrs. R. B. Templeton, the branch also had the pleasure of entertaining Mr. and Mrs. N. P. Newman, Mr. and Mrs. J. J. Sheehan, Mr. Tom Makemson and Mr. George Lambert, Secretary and Assistant Secretary of the Institute. It was quite obvious that everyone who attended this function enjoyed themselves to the utmost.

At the January Meeting, Mr. G. L. Harbach, Chief Metallurgist to Worthington Simpson, presented his Paper and slides on "Synthetic Resin Core-Binders." This Meeting was particularly well attended, and was followed by a lively discussion.

The February Meeting was held in the Gaumont-British private picture theatre so as to accommodate the large crowd anticipated for hearing Mr. A. R. Wizard's Paper, slides and film on "Art Foundry Practice." No fewer than 148 Members and visitors attended.

On March 25 there was held a Dinner for men only at the Criterion Restaurant. This was a new venture in that it was additional to the Dinner and Dance in December, but it was felt that the Council was completely justified in holding this function, as over one hundred Members attended, and the evening was deemed to be a great success.

At the March Meeting, Mr. W. W. Braidwood, of the Mond Nickel Company, presented his Paper and slides on "What is Acicular Cast Iron?" which was much enjoyed by all.

Work of the Sections

The two Sections at Ipswich and Slough had both had successful sessions, and thanks were due to their officers, Mr. L. W. Sanders, President, and Mr. A. N. Summer and Mr. L. W. Sanders, Hon. Secretaries, and also to Mr. F. C. Evans and Mr. Raybould, President and Hon. Secretary respectively of the Slough Section. The Branch was extremely sorry to lose the services of Mr. A. N. Sumner, Hon. Secretary of the Ipswich Section, which office he had to relinquish on his transfer to Scotland, and he was sorry to say that Mr. Raybould, Hon. Secretary of the Slough Section, found pressure of work precluded his continuing his office there. The council was most grateful both to Mr. Sumner and Mr. Raybould for all the hard work they had put in, and also to Mr. L. W. Sanders for taking on the job of Hon. Secretary at Ipswich.

General

The attendance at Branch Council Meetings has been very good, particularly by the past-Presidents of the Branch. He really did not know what they would do without their wise judgment based on their long experience of Institute matters.

In conclusion, he expressed the thanks of members to Mr. Frank Hudson, who represented the Branch on the Technical Council, to Mr. Harwood Brown, and Mr. George Pierce, who had looked after the Register at all Meetings, and to Mr. Ellis for working the lantern.

In laying down the reins of office as Hon. Secretary of this Branch, he thanked most warmly all the Members of the London Branch who had made his work a pleasure, and he was satisfied that Mr. W. G. Mochrie, who followed him, would be more than equal to the job which he had so kindly undertaken.

In proposing the Report's adoption, MR. V. C. FAULKNER (Past-President of the Institute) recalled that not many years ago the Branch had had a membership of only one hundred, and it was gratifying to learn that within a comparatively short time it had grown to over seven hundred. The way in which the Branch had been conducted was a "model"; there were plenty of activities, both social and technical, and the lectures had been well chosen. Praise was due to the Hon. Secretary for having presented such an excellent picture of what the Branch had been doing during the past year.

The proposition was seconded by the Branch-President and unanimously accepted.

Election of Officers

The following officers were then elected:—As *Branch-President*, Mr. F. Arnold Wilson; as *Senior Vice-President*, Mr. Frank Tibbenham; as *Junior Vice-President*, Mr. L. G. Beresford; as *Hon. Secretary and Treasurer*, Mr. W. G. Mochrie; as *Hon. Auditors*, Mr. V. Delport and Mr. C. Cleaver; as *Members of Council*, Mr. P. T. Holligan, Mr. B. Levy and Mr W. A. Turner; as *Branch Delegates to General Council*, Mr. E. M. Currie, Mr. V. Delport, Mr. C. H. Kain and Mr. P. D. Pincott; as *Representative to the Technical Council*, Mr. F. Hudson, F.I.M. The President proposed, and Mr. F. Arnold Wilson seconded, that Mr. E. Harwood Browne and Mr. George C. Pierce be reappointed stewards, and Mr. Ellis as lanternist for the ensuing year; this proposition was carried unanimously.

Retiring President's Review

MR. PINCOTT, expressing his appreciation of the help he had received during his year of office, mentioned particularly the name of Mr. F. Arnold Wilson, who, as always, had known all the answers and had proved to be a grand leaning post. Another valued friend had been Mr. Faulkner, that philosopher of the Institute and the London Branch in particular. Thanks were also expressed to the present staff of the FOUNDRY TRADE JOURNAL, Mr. Parkes and the reporters, who had given so much time to the publicity side of the Branch's activities. The Past-Presidents also had been of inestimable help and he thanked them for their unstinted assistance.

"*Bronze Founding*" *Film*

The PRESIDENT then invited Mr. F. Hudson, F.I.M., to present the film dealing with "Bronze Founding," of which it was desired that members would act as critics. The film was intended to attract newcomers to the foundry industry and this preview had as its purpose the fostering of interest on the part of members of the London Branch.

DISCUSSION

The PRESIDENT, opening the discussion after the presentation of the film, said it was of a most absorbing character, and would appeal to young and old alike.

MR. E. R. MORT observed that on two occasions the film had shown the use of a vertical oven in connection with core drying, and he questioned whether the significance of it would be apparent to a boy.

MR. E. H. BROWNE considered that the film possessed many elementary characteristics which would appeal strongly to the type of boy the industry was anxious to attract. The two things in particular which he felt worthy of special mention were the shots of the melting and the chemical laboratory, and he was delighted that they had been given prominence.

MR. A. R. WIZARD was of the opinion that the introduction to the film was too long, though the film itself was very soundly produced and would assist considerably towards promoting interest in the right quarters. It was unfortunate, however, that throughout the entire film there was no complete view of a foundry and he considered it to be a serious omission. A comprehensive picture would have been very desirable because he felt that the naturally enquiring mind of a boy would reach beyond each individual piece of machinery. Certainly the most important technical points had been covered, but that was too advanced for a beginner, and generalities on a wider scale would have been preferable. The general set-up of a foundry would attract more interest than a mere graphic plan.

MR. BRIGG said that some years previously he had seen a Firth-Vickers colour film which had included many long-range shots and which gave more evidence of natural colour and lighting than the bronze-founding production. His further criticism was that too many human backs were seen rather than the actual process dealt with by the hands, particularly in the metallurgical laboratory scene.

DR. A. B. EVEREST considered that several shots were taken at points too close to the object, with the result that certain important factors were not shown. In the pouring of the metal, for example, the crucible was entirely out of the picture and in the tensile testing the top part of the test-piece disappeared when the break occurred.

MR. ROSE suggested that at the close of the film there should be included an announcement advising boys to apply to the manager of the local Junior Employment Exchange for a list of local foundries.

Reply to Criticism

MR. F. HUDSON, in reply, said it was interesting to note that so far as Frank Phillips, the film commentator, was concerned, he had actually worked in a foundry during the war and therefore his experience had helped him considerably.

Replying to Mr. Mort, he said that in making a film of the type under review, one had to strike a balance and make provision for appeal to the widest possible audience. The point raised by Mr. Mort had actually been given consideration from that angle.

Concerning Mr. Wizard's comments, he said that, when the film was in production, a number of long views were taken as a natural sequence. Unfortunately, however, they were not considered to be good enough and consequently were withdrawn because at the present time there was no high-speed colour film to be obtained, and, furthermore, the type of lighting available was not suitable. When high-speed colour film was marketed, then doubtless the more general views needed would be possible.

MR. CROWE, representing the Foundry Film Service, said he was pleased to receive the criticisms and felt that generally the film had been accepted favourably. He mentioned that it had been sponsored by the Association of Bronze and Brass Founders.

The formation of the Foundry Film Service was in the nature of an experiment and its intention was to endeavour to provide the right kind of film at the lowest cost, to the requirements of the foundry industry as a whole, for the purposes of propaganda. In many respects the future of the Service was in the hands of the members of the foundry profession and it was hoped that every opportunity would be taken to make good use of it.

The film on "Bronze Founding" was the first to be made and it was intended to make pictures dealing with both iron and steel castings, if thought necessary or desirable. A great deal of experience had been gained in the making of the film and it was confidently hoped that future productions would be better.

Vote of Thanks

MR. L. G. BERESFORD, proposing a vote of thanks to Mr. Hudson for presenting the film, said that as that gentleman was associated with it, a successful and interesting evening had been assured. It was realised, of course, that the object of the picture was, primarily, to attract young labour to the foundries.

The criticism that there was not enough of the actual foundry included in the picture was correct, and he felt that prospective recruits to the profession would want to know something more about the kind of surroundings in which they would work. Apart from that, the production was excellent and compared favourably with Mr. Hudson's previous film on precision casting, which in itelf was a model; praise was due to him and to his colleagues for a valuable contribution to the furtherance of the founding industry.

MR. W. WILSON seconded Mr. Beresford's proposal. His only criticism was that there were no pictures of boys working in a foundry, and he felt that scenes of some of them at work, instead of the men, would have greater appeal to potential entrants. Recruitment had been well in front of the minds of all those engaged in foundry work and that sort of appeal was necessary to attract young labour.

News in Brief

THE MANCHESTER REGIONAL OFFICE of the Board of Trade is now at 76, Newton Street, Manchester, 1.

A NEW SALES OFFICE has been opened at 351, Sauchiehall Street, Glasgow, C.2, for the Light Engineering Division of Sheepbridge Engineering, Limited.

THE DUKE OF EDINBURGH was shown a scale model of the marine gas-turbine engine now being developed for the Admiralty when he visited the Rolls-Royce works at Derby on June 27.

LONG-SERVICE AWARDS were presented to 228 employees (with a total of 4,170 years' service) of the John Thompson (Engineering) Company, Limited, Wolverhampton, on June 20.

THE WORKS OF Follsain-Wycliffe Foundries, Limited, Lutterworth, near Rugby, will be closed for the annual holiday from July 29 to August 8, during which time no goods will be despatched or received.

THE HARBOROUGH CONSTRUCTION COMPANY, LIMITED, manufacturers of foundry supplies, of Market Harborough, has appointed Barcon, Limited, Rutherglen, Glasgow, to act as its agents for the whole of Scotland.

BRIGHTSIDE FOUNDRY & ENGINEERING COMPANY, LIMITED, Sheffield, has obtained C.I.C. permission to make a bonus issue to ordinary shareholders of one 5s. share for each one held. An extra-ordinary general meeting will be held on October 10.

BARTRAM & SONS, LIMITED, Sunderland, has received an order from Royal Interocean Lines, Amsterdam, for a single-screw cargo motorship of 8,800 tons dw. The vessel will be engined by the North Eastern Marine Engineering Company (1938), Limited.

A BAR OF PIG-IRON marked "Corngreaves" was discovered recently by workmen who were sorting metal at Old Hill, Staffs. The Corngreaves Ironworks were closed down 80 years ago, and the bar has thus escaped the furnaces and the scrap drives of two world wars.

A PLAQUE in memory of 75 employees from division headquarters and the Kynoch Works of Imperial Chemical Industries, Limited (Metals Division), Witton, who "gave their lives in the cause of freedom" in the war, was unveiled on June 27 at the Witton entrance of the Kynoch Works by Mr. H. E. Jackson, chairman of I.C.I. (Metals Division).

SPENCER-BONECOURT, LIMITED, a subsidiary of Babcock & Wilcox, Limited, has, in conjunction with West's Gas Improvement Company, Limited, received an order from the West Midland Gas Board for the supply of a gas-turbine driven alternator to operate in conjunction with the latest installation of Glover-West continuous vertical retorts on order for Foleshill Gasworks at Coventry.

A NEW 2,000-H.P. main-line Diesel locomotive, with a maximum speed of 84 m.p.h., is being built at Derby by British Railways. Power from the four 500-h.p. engines will transmit mechanically instead of electrically to the driving wheels, and this will lessen power losses. The locomotive will have two driving cabs, so that it can be driven from either end, and will have a 4-8-4 wheel arrangement.

THE APPLEBY FRODINGHAM BRANCH of the United Steel Companies, Limited, announces that two of its blast furnaces broke a nine-year-old record in the week ended June 18 with an output of 7,200 tons—80 tons more than the previous best in August, 1940. The melting shop of John Lysaght, Limited, Scunthorpe, also achieved a record during that week by producing 8,205 tons—489 tons more than the previous highest figure.

A FURTHER CAPITAL BONUS in preference shares is proposed by the directors of Grayson, Rollo & Clover Docks, Limited, Liverpool. The bonus involves 157,650 5 per cent. £1 cumulative preference shares in the proportion of one for every eight ordinary shares of 2s. 6d. each held on June 28. Treasury consent has been given. The previous capital bonus was the 50 per cent. in ordinary shares in March, 1948, before the lifting of the bonus tax.

VENTRA AGENCIES, P.O. Box 1783, Salisbury, Southern Rhodesia, desires to obtain the agency of a United Kingdom manufacturer of a full range of induction motors. Firms interested should write direct to the company at the above address, at the same time notifying the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1 (reference, C.R.E. (I.B.) 17083/49), of any action taken.

THE NAME OF THE Disabled Persons Employment Corporation, Limited, has been changed to Remploy, Limited. "Remploy" is the name given to the special factories established in different parts of the country by the Corporation for the purpose of giving employment to disabled persons whose disability is so serious as to prevent them from obtaining employment under normal industrial conditions. There are at present 56 Remploy factories in operation.

SECOND-CLASS MAIL FOR Canada (including Newfoundland), the United States and Mexico may now be sent by air mail at the reduced air postage rate of 4d. per ½ oz. This new service will apply to printed papers, commercial papers, samples, etc. Small packets may also be sent by this service to the United States and Mexico. Second-class air mail should conform to the general regulations already governing the various categories of second-class mail sent by surface route.

R. & W. HAWTHORN, LESLIE & COMPANY, LIMITED, is planning extensions to its St. Peter's Works, St. Lawrence Road, Newcastle-upon-Tyne. In order to carry out the scheme the company proposes moving the main entrance gates westwards for about 45 yds. along St. Lawrence Road, and the City Council has been asked to agree to the closing of part of the road. The land on either side of this road is the property of the firm, and the road is only used for access to the works.

BETWEEN 100 AND 200 WORKERS of Accles & Pollock, Limited, weldless steel-tube manufacturers, etc., of Oldbury, have been dismissed as redundant owing to a falling-off in the firm's orders. Mr. Walter Hackett, junr., joint managing director of the company, has stated that the drop in orders was about equally divided between home and export markets. "The seller's market has gone, and we are now finding very strong competition from America, Germany, Italy, and Belgium," he said.

THE ESTABLISHMENT of a Highland Technical College, especially in view of the development of hydro-electric schemes, was one of the provisions for technical education in the Highlands advocated by Dr. J. Cameron Smail, Principal of Heriot-Watt College, Edinburgh, at the first session in Edinburgh on June 24 of the summer meeting of the Association of Technical Institutions. Technical education ought to be playing its part to prepare the people of the country to utilise the facilities which they would have, he said.

MAJOR W. A. DUNCAN SMITH, chairman and managing director of Duncan Smith & Company (Africa), Limited, Leopoldville, Belgian Congo, wishes to get in touch with manufacturers of contractors' plant, agricultural machinery, heavy Diesel lorries, and fuel tankers. Firms interested should send catalogues, etc., direct to Major Smith at 23-25, Anston Street, Collyhurst, Manchester, 9, at the same time notifying the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1 (reference, C.R.E. (I.B.) 17456/49), of any action taken.

APPLICATION IS TO BE MADE to the Council of the Stock Exchange, London, for permission to deal in and quotation for the whole of the preference shares capital of Le Grand, Sutcliff & Gell, Limited. The existing issued capital of the company is £175,000, consisting of 75,000 7 per cent. cumulative preference shares of £1 and 100,000 ordinary shares of £1, and a further 25,000 preference shares are being issued. The business, which was started in 1872 and was later turned into a limited company, provides services in connection with the supply of water from underground sources and site investigations and the production of ferrous and non-ferrous castings and specialist equipment for the oil industry.

THE MINISTRY OF SUPPLY has announced that one wing of the new radiochemical laboratory at the Atomic Energy Research Establishment at Harwell, Berks, is now ready, and that scientists are to begin work in it almost immediately. The building is said to be the most complicated project of its kind ever undertaken on this side of the Atlantic. The laboratory will be used primarily for research on the chemical problems of separating the fissile element plutonium from uranium rods that have been irradiated in a pile. The rods contain very radioactive "fission products," and the chemical separation problem involved means that the scientists will be tackling one of the most difficult jobs in the atomic energy programme.

MR. JOSEPH MORLEY, chairman of Meters, Limited, Manchester, in a statement circulated with the annual accounts, says that the year's trading has not been without its difficulties, although in most of the company's products record figures have been achieved. "With the nationalisation of the gas industry, almost our entire production is for State-owned industry and one cannot foresee the effects of this on our group. Of the outlook for the current year," he says, "confidence can be taken from the fact that, in face of keen competition from America and from Europe, the company in December last secured the contract for the supply of gas meters to the Argentine State Gas Department."

Obituary

MR. C. W. HARSLEY, who died recently, was Sheffield district manager of the Edison Swan Electric Company, Limited.

MR. JOSEPH PARK DAVISON, late managing director of the Whitehead Torpedo Company, Limited, Weymouth, died on June 22 at the age of 72.

MR. JAMES ANTHONY FIELD BEALE, a director of the Universal Grinding Wheel Company, Limited, Stafford, died in London on June 25. He was 42.

MR. PERCIVAL BROTHERTON, who died on June 23, was a director of W. Canning & Company, Limited, electroplaters' engineers, of Birmingham, for 26 years. Mr. Brotherton, who was 70, joined the firm 40 years ago.

MR. WILLIAM HENRY BARKER, head of the firm of W. H. Barker & Son (Engineers), Limited, colliery and structural engineers, of Fenton, Stoke-on-Trent, died recently. The funeral on June 25 was attended by fellow magistrates and many business associates.

DR. ROBERT ROBERTSON, who died on June 21—less than a week after celebrating his 90th birthday—had a long and distinguished career in engineering. He had been in ill-health for some time. Dr. Robertson, a former Deacon-Convener of the Trades House of Glasgow and Dean of Guild in Glasgow, was a governor for 42 years of the Royal Technical College, Glasgow, becoming chairman of the governors in 1930. He was a life member of the Institution of Civil Engineers, of the Institution of Electrical Engineers, and of the Institution of Engineers and Shipbuilders in Scotland. He was a member of the firm of Strain & Robertson, consulting engineers, of Glasgow, C.2, from 1885 to 1923, eventually becoming senior partner of the firm. His services were employed in the promotion of the Clyde Valley Electrical Power Company, and he became a director of the company in 1916, while in 1940 he was appointed chairman of the organisation and its associated companies. After his retirement from business as a consulting engineer in 1923, Dr. Robertson devoted greater attention to public affairs, his public services being recognised in 1935, when he was created a Deputy-Lieutenant of the City of the County of Glasgow. Glasgow University conferred upon him the honorary degree of Doctor of Laws.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference E.P.D. or C.R.E. can be obtained from the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1.

EGYPT, July 18—House service meters and time limiting switches, for the Cairo Electricity and Gas Administration. (Reference: C.R.E. (I.B.) 16624/49; Room 1076.)

SWADLINCOTE AND ASHBY, July 18—Contract No. 2.—Supply of about 10 miles of 12in. and 10-in. dia. spun- or cast-iron concrete-lined water mains. Contract No. 3.—Valves and fittings, for the Joint Water Board. Pick, Everard, Keay & Gimson, 6, Millstone Lane, Leicester. (Deposit, £2 2s. each contract.)

Company News

(Figures for previous year in brackets.)

J. & E. HALL—Interim dividend of 2½% (same).

KENDALL & GENT—Interim dividend of 5% (same).

N. HINGLEY & SONS—Second interim dividend of 5%.

W. & T. AVERY—Final dividend of 15%, making 20% (same).

GOODLASS WALL & LEAD INDUSTRIES—Dividend of 15% (same).

BROMILOW & EDWARDS—Dividend of 10% and bonus of 2½% (same).

GREENWOOD & BATLEY—Final dividend of 10%, making 15% (same).

DARLINGTON & SIMPSON ROLLING MILLS—Dividend of 9% (same).

A.B.C. COUPLER & ENGINEERING COMPANY—Dividend of 20% (same).

SPURLING MOTOR BODIES—Final dividend of 25%, making 37½% (same).

MITCHELL, SHACKLETON & COMPANY—Interim dividend of 4% (3%).

CHUBB & SON'S LOCK & SAFE COMPANY—Final dividend of 10%, making 15%.

RICHARD THOMAS & BALDWINS—Final dividend of 10%, making 15% (same).

EDMUNDS, WALKER & COMPANY—Final dividend of 30%, making 60% (same).

WALSALL CONDUITS—Final dividend of 35% and bonus of 15%, making 70% (same).

STANCROFT—Final dividend of 35%, making 50% (37½%, equivalent to 50% per annum).

B. & S. MASSEY—Final dividend of 15% (17½%) and bonus of 5% (nil), making 22½% (17½%).

SCOTTISH MACHINE TOOL CORPORATION—Final dividend of 5%, making 8% (same).

PRINCE OF WALES DRY DOCK COMPANY SWANSEA—Dividend of 7½% and bonus of 5% (same).

REVO ELECTRIC COMPANY—Final dividend of 12½% and cash bonus of 10%, making 27½% (same).

WILKES BERGER ENGINEERING COMPANY—Dividend of 10% (20%), less tax, and cash distribution from capital profits of 10% (5%), tax free.

NEWMAN, HENDER & COMPANY—Final dividend of 7½%, making 12½% on larger capital (12½%). The company was made public on December 6, 1948.

GENERAL CABLE MANUFACTURING COMPANY—Interim dividend of 20% (same). Proposed bonus shares of two for three held rank from July 7.

FRANCIS MORTON & COMPANY—Final dividend of 7½% and bonus of 5%, making 20% (same). The directors propose to sub-divide the existing preference and ordinary shares of £1 into 5s. shares.

DERITEND STAMPING COMPANY—Net profit for the year ended February 28, after taxation, depreciation, etc., £22,462 (£38,973); tax over-provided, £2,692 (£14,853); war risks insurance reserve not required, nil (£3,000); final dividend of 5%, making 10% (same); to general reserve, £15,000 (£35,000); forward, £60,134 (£59,550).

RAILWAY & GENERAL ENGINEERING COMPANY—Net profit to March 31, after depreciation, etc., £9,137 (£3,646); profits tax overpaid, nil (£4); to taxation, £4,302 (£867); preference dividend (on increased capital), £615 (£473); ordinary dividend (on increased capital), of 8⅔% (same), £3,609 (£1,930); additional directors' fees, nil (£351); forward, £8,557 (£7,946).

KEITH BLACKMAN—Trading profit for the year ended March 31, £302,496 (£222,051); interest, £540 (£65); to audit fee, £1,120 (£961); depreciation, £26,150 (£26,276); taxation, £150,000 (£120,000), including £25,000 to future tax reserve; pensions reserve, £75,000 (development reserve £37,124); dividend of 20% (same) and bonus of 5% (nil); forward, £58,973 (£48,632).

HATTERSLEY (ORMSKIRK)—Net profit to March 31, after depreciation, etc., £327,785 (£314,866); brought in, £16,665 (£15,884); provisions not required, £15,000 (nil); to tax, £193,391 (£189,710); obsolescence and replacements reserve, nil (£40,000); staff pensions reserve, £10,000 (nil); general reserve, £100,000 (£50,000); dividend of 17½% and bonus of 7½% (same); forward, £21,684.

ASSOCIATED LEAD MANUFACTURERS (formerly Walkers, Parker & Company)—Net profit, after taxation, for 1948, subject to audit, £195,191; with credits from previous years of £31,384, less stamp duty written off, £3,027, and transfers to reserves of £54,269, there remains £169,279 (£210,177), which has been declared as dividend. The entire share capital is owned by Goodlass Wall & Lead Industries.

FULLERS' EARTH UNION—Net profit for the year to March 31, after depreciation, etc., £212,314 (£124,140); E.P.T. refund, nil (£16,115); to income tax, £100,000 (£67,310); written off subsidiary, £5,999 (nil); reserve against subsidiary, £10,792 (nil); reserve funds, £58,507 (£35,000); final dividend of 11% and bonus of 5%, making 20% (same) on the old ordinary shares, together with a dividend of 16% on the new ordinary shares subscribed January, 1949; forward, £69,176 (£46,979).

ENGINEERING & LIGHTING EQUIPMENT COMPANY—Net profit for the year ended March 31, after depreciation, income tax, etc., £14,811 (net loss £17,744); reducing adverse balance from £22,147 to £7,336; balance sheet note states the company has power to issue further shares to nominal amount of £35,156 and that the dividend on the 64,844 7% cumulative preference shares due for the 2½ years ended December last amounting to £11,348 (gross) has not been paid.

TILLING-STEVENS—Consolidated trading profit for the year ended March 31, after all selling and administrative charges, £125,925 (£113,356); to directors' remuneration, £9,429 (£1,392 fees only); bank interest, £3,251 (£2,037); depreciation, £14,253 (£10,482); audit expenses, £535; leaving £98,457 (£90,975); to tax, £48,647 (£42,400); balance, £49,810; brought in, £61,608 (£54,154); to general reserve, £25,000 (£15,000); materials reserve, nil (£20,000); dividend of 7½% (5%); balance, £77,237.

N. GREENING & SONS—Consolidated gross trading profit for the year to April 30, £183,944 (£174,990); other income, £3,156 (£3,358); to tax, £91,760 (£95,960); replacement reserve, £8,000 (same); auditors' remuneration, £245 (same); net profit, £87,095 (£74,143); to dividends, £14,781 (£14,276); general reserve, £50,000 (£40,000); fixed asset replacement reserve, £22,000 (£12,000); stock reserve, nil (£10,000); written off goodwill, etc., of subsidiary, £480 (nil); forward, £31,500 (£28,426).

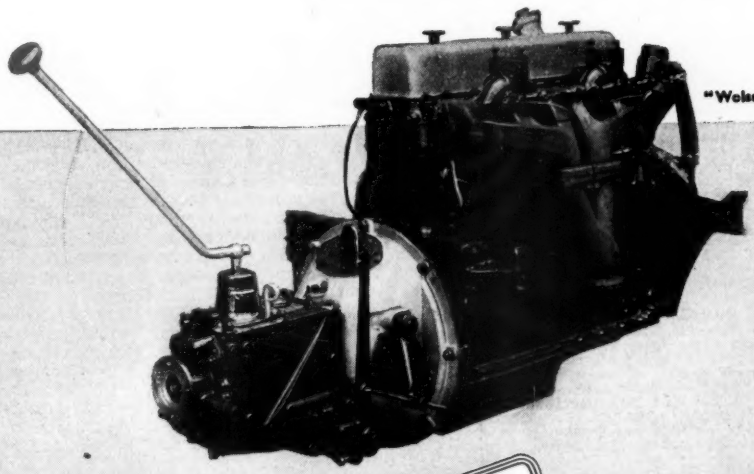
INBUCON—Consolidated profit to March 31, after directors' remuneration, £102,385 (£76,206); sale of investments, £281 (nil); investment income, £1,247 (£1,248); fees, £18 (£26); to depreciation, £180 (£200); audit fees, £105 (same); tax, £55,243 (£44,500); tax adjustment of prior years, £1,161 (£3,508 credit); net profit, £47,242 (£36,183); parent's net profit, £47,242 (£36,183); brought in, £2,237 (£2,554); final dividend of 10% (8%), making 12% (10%); general reserve, £27,000 (£20,000); forward, £2,679.

MILNER'S SAFE COMPANY—Consolidated trading profit for the year ended March 31, £47,593 (£30,856); to directors' fees and commission, £1,990 (£1,758); other emoluments £5,935 (£7,513); adjusted wartime contracts, £2,553 (nil); depreciation and amortisation, £10,560 (£9,710); tax, £14,100 (£1,648); outside shareholders, £12 (£20); retained by subsidiaries, £368 (£883); net profit attributable to parent company, £12,065 (£9,324); dividend of 7½% (same); forward, £29,528 (£23,651).

WOLSELEY SHEEP SHEARING MACHINE COMPANY—Group trading profit for 1948, £33,203; investment income, £30; miscellaneous income, £216; to depreciation of buildings, plant and equipment, £8,675; auditors' remuneration, £355; U.K. tax, £14,148; leaving £10,271; retained by subsidiaries, £805; balance, £9,466; parent's income, £9,466; brought in, £25,964; to amounts transferred in respect of subsidiaries for previous years, £815; dividend of 12½% (same); forward, £27,740.

W. G. ALLEN & SONS (TIPTON)—Trading profit to March 31, after all expenses, £50,770 (£33,427); to depreciation, £6,335 (£3,789); auditors' remuneration, £300 (same); interest, £2,379 (£3,358); taxation, £19,938 (£4,693); net profit, £21,818 (£21,357); written off land and buildings, £1,666

(£2,117); patents, nil (£1); capital reorganisation expenses



"Wolseley 14 h.p. Engine."

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REFINED PIG IRON

USED AND RECOMMENDED
FOR ALL HIGH-DUTY
ENGINEERING CASTINGS

THE STANTON IRONWORKS COMPANY LIMITED, Nr. NOTTINGHAM

(£2,117); patents, nil (£1); capital reorganisation expenses, nil (£591); to general reserve, £11,000 (£7,000); deferred repairs reserve, nil (£2,000); final dividend of 7½%, making 10%, £6,754 (same); forward, £8,376 (£8,040).

CAKEBREAD, ROBEY & COMPANY—Consolidated trading profit for 1948, including investment income, £106,445; balance, after depreciation, tax, etc., £61,200 (£63,560); brought in, £19,493 (£18,590); to future tax provision, £25,450 (£25,250); written off goodwill, £2,405 (nil); general reserve, £10,000 (£7,000); stock reserve, £5,000 (£10,000); deferred repairs, £2,000 (nil); dividend equalisation, nil (£5,000); staff contingency, £1,000 (nil); bad debts reserve, nil (£2,000); final dividend of 15% and bonus of 2½%, making 22½% (same); forward, £21,432.

SCAFFOLDING (GREAT BRITAIN)—Consolidated trading balance to September 30, 1948, £278,434 (£181,224); investment income, etc., £92 (£101); to directors' remuneration, £10,071 (£8,054); depreciation, £18,830 (£12,832); audit fees, £684 (£660); deferred repairs, £5,000 (£19,398); dilapidations, £1,000 (same); leaving £242,941 (£139,381); to profits tax, £35,000 (£40,000); brought in, £21,938 (£16,677); E.P.T. repayable, nil (£19,755); making £229,879 (£135,813); to general reserve, £60,000 (£20,000); income tax, £110,934 (£74,614); dividend of 10% and bonus of 10% (same); forward, £39,684.

WILLIAM BAIRD & COMPANY—Trading profit for 1948, consisting of dividends from subsidiary and associated companies and income from other investments, heritable properties, etc., and after providing for all charges, £382,643 (revenue £387,262 for seven months of parent company, but included year's subsidiary and associated company dividends); to debenture interest, £9,958 (£6,151); imperial taxation, £168,392 (£169,739); (net profit, after tax, but subject to directors' fees, £211,391); to staff superannuation reserve, £5,000; final dividend of 11%, making 15% (same); forward, £266,415 (£223,876).

METERS—Trading profit of group for the year to March 31, £54,550; investment income, gross, £3,748; profit on sale of land and buildings, £31,376; profit on investments, £1,204; to depreciation of fixed assets, £18,052; investment in subsidiaries written off, £2,163; directors' fees, £575; emoluments, £14,971; past pension, £750; audit, £693; taxes, £13,181; to holding company (net profit), £30,741; subsidiaries, £9,233; outside shareholders, £519; credit, £4,304 from repairs reserve; to preference dividend, £4,538 (£4,396); investment reserve, £15,000 (against £10,000 to general reserve); final dividend on ordinary shares of 6% (same), making 10%; forward · holding company £21,233, subsidiaries £13,247, outside holders £842.

ALLIED IRONFOUNDERS—Consolidated trading profit for the year ended March 31, £1,712,948 (£1,442,892); investment income, £52,377 (£43,806); surplus from variation in basis of stock valuation, £96,746 (nil); unrequired provisions, £9,405; to depreciation, £146,233 (£174,231); directors' fees, £900 (£825); directors' commission, £36,424 (£27,470); tax, less previous overprovision, £917,348 (£751,158); profit, £789,636 (£547,627); brought in, £438,549 (£316,818); subsidiary balances, £2,720 (debit £5); to reserve for replacement of fixed assets, £200,000 (£150,000); stocks reserve, £150,000 (nil); pensions reserve, £50,000 (£70,000); general reserve, £50,000 (nil); final dividend of 10% (12½%), making 17½% (same); forward, £575,003.

FOLLSAIN-WYCLIFFE FOUNDRIES—Consolidated trading profit for 1948, £35,574 (£36,861); other income, £141 (£288); net profit, before tax, £24,365 (£27,503); excess provision for contingencies, £941 (£1,395); brought in, £10,970 (£15,817), making £36,276 (£45,040), including £325 sale of designs; to tax, £20,100 (£18,263); cost of merger scheme, £1,678 (£1,067); provisions for collections, £4,750 (nil); written off goodwill and patents, nil (£14,636); minority holders' interest, nil (£170); parent company's net profit, before tax, £27,479; final dividend of 18%, making 24% on the ordinary shares; final dividend of 3% on the preference shares, plus participating dividend of 8.46%, making 14.46% for the year; forward, £14,300.

THE BUSINESS previously carried on by Mr. James Wilson, at St. Andrew's Road, Huddersfield, has now been taken over by James Wilson (Huddersfield), Limited, at the same address. There is no alteration in the personnel and business will be carried on as previously.

Simplified Practice in Industry

The application of simplified practice in American industries and the applicability of similar techniques to British industries is to be studied by a panel of six experts from Britain. The visit is under the auspices of the Anglo-American Council on Productivity and members of the panel, who left in the Queen Mary on June 30 will follow the course charted by the Council at its second session last April, when emphasis was laid on standardisation, simplification and specialisation. The Council attaches particular importance to the immediate benefits to be derived from the intermediate process towards full standardisation, known as simplified practice, which aims at limiting the ranges of sizes or grades of products in order to cut costs and increase output by enabling longer runs to be made in production processes.

The panel will hold discussions with U.S. Government agencies, national organisations, trade associations, and firms. Its aim will be to form an appreciation of what has been achieved in this field, the methods employed, the degree of success, and the effect on productivity and cost. The panel will also have the task of assessing how far this experience could be adapted to British conditions and the extent to which it would be of benefit to British industry.

The members of the panel are as follow:—Major-Gen. J. S. Crawford, a director of Guy Motors, Limited, Wolverhampton, vice-president of the Society of Motor Manufacturers and Traders and chairman of its Standardisation Committee; Mr. C. A. Martin, of the British Thomson-Houston Company, Limited, Rugby; Mr. Robert Neill, a director of the Lucas Electrical Company, Limited, Birmingham; Mr. G. Weston, deputy director of the British Standards Institution; Mr. Bertram White, technical director of the Federation of British Industries; and Mr. C. J. A. Whitehouse, secretary to the Ministry of Supply Committee on Standardisation.

Disposal of Surplus Non-ferrous Metals

The functions of the Disposals Section of the Non-ferrous Metals Directorate have been transferred to the Contracts Division of the Ministry of Supply. Inquiries regarding Government-owned surplus non-ferrous metals (scrap and semi-manufactured) should be made in the first instance to:—Ministry of Supply, Contracts Division (Disposals/R.E.7), Great Westminster House, Horseferry Road, London, S.W.1 (telephone: Victoria 3811). Payment for surplus non-ferrous metals should be made to the Ministry of Supply, A.G.42(d), Adelphi, John Adam Street, London, W.C.2, instead of to Rugby.

These changes apply only to metal sold as surplus and do not affect virgin non-ferrous metals.

FULLWOOD FOUNDRY COMPANY, LIMITED, Mossend, is to erect baths at Burnbank Road, adjoining its Hamilton works, at a cost of about £7,000.

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Raw Material Markets

Iron and Steel

The trade generally is obtaining good outputs, for which current production of all grades of foundry pig-iron and hematite is utilised. While available supplies of pig-iron now more nearly approximate the requirements of the foundries than has been the case for some time, there remains a persistent demand for high-phosphorus pig-iron for the light foundries, and for low- and medium-phosphorus and hematite for the engineering, jobbing and speciality foundries. In fact, the furnaces producing these grades still find it necessary to ration out supplies so as to ensure equitable distribution. The light foundries, in particular, continue to meet difficulties in securing all the high-phosphorus iron they need, especially from those furnaces whose production is below normal due to blowing out for rebuilding or relining. The overall output of this grade of iron still shows a reduced tonnage from previous outputs, and present supplies are not such as to provide ample stocks at either the furnaces or the foundries after current requirements have been met.

The demand for low- and medium-phosphorus pig-iron for the engineering, jobbing and speciality foundries shows no abatement, and the present call for these grades represents a tonnage greater than current production can satisfy. All available supplies of hematite are also readily accepted by them, but tonnages are not too plentiful, although there is some improvement due to a temporary easing in the supply position of basic pig-iron. The refined grades can be obtained fairly easily and makers generally are able to meet demands.

An insistent demand continues for cupola scrap, both cast-iron and steel, although the supply position is easier in some areas. Foundry coke supplies are coming forward satisfactorily, while supplies of ganister, limestone and firebricks are being received in the required quantities.

Good outputs from the re-rollers have been made possible by the tonnages obtained from abroad, which have changed their position from one of extreme scarcity to a sufficiency for current needs. Consumers of light sections and bars and narrow strip are receiving tonnages more in keeping with their requirements, and the mills are able to deal with their export commitments more expeditiously. Sheet bars are also more plentiful than they have been for some time, with a consequent improvement in the output of sheets. There is a heavy demand for sheets, both black and galvanised, and makers are committed for some months ahead. The heavier mills have also received good tonnages of steel from the Continent and these, together with supplies from home works, ensure good outputs of the larger sections, bars and wide strip.

Under the Control of Iron and Steel (No. 72 Order), which came into operation on June 28, the price of spiegeleisen is raised from £16 14s. 6d. to £17 8s. Cast-iron rainwater and soil goods, gutters and connections, which were previously subject to an addition of 71½ per cent. to the prices set out in the Deposited Schedules, are now subject to an addition of 72½ per cent.

Non-ferrous Metals

Prices of copper, zinc and lead in the United States and in this country show no change and markets are still featureless. The June-July buying wave in the U.S., anticipated in some quarters on the basis of consumers being forced into the market, has so far failed to arrive, and September-October, following the holiday period, is now more generally spoken of as the period of a resurgence of demand. There is a belief in America that the Government intends very shortly to purchase good tonnages of copper and lead for the stockpile and the quotation of 16 cents and 12 cents per lb. respectively, are, in consequence, not under very heavy pressure. On the other hand, the 9 cents price level for zinc is not expected to be bolstered up by stockpile buying, the holding being already too great in proportion to other metals, and a large-scale cut in output is deemed to be necessary. U.S. fabricators shipped 61,400 short tons of copper in their products during May, which compares with 32,600 short tons of intake of copper and indicates a heavy drawing on stocks. Imports into the United Kingdom during May were:—Copper, 24,755 tons (April, 31,522 tons); zinc, 18,147 tons and 2,496 tons of concentrates (April, 18,491 and 11,240 tons); lead, 19,755 tons (April, 24,280 tons).

Curtailment of production is spreading, but at the same time efforts are being made by producers to cut down their costs. Only the cheapest of them can feel assured that they will be outside the ranks of marginal producers if the new price levels to be established are very much below those now quoted. For the year 1938 and the first eight months of 1939, U.S. quotations averaged 10.65 cents per lb. for copper, 4.80 cents for zinc and 4.90 cents for lead; the end of the war found them at, respectively, 12.00 cents, 8.25 cents and 6.50 cents per lb. Following the post-war scramble for supplies, in which the American stockpiling authority participated, when quotations reached peaks of 23.50 cents for copper, 17.50 cents for zinc and 21.50 cents per lb. for lead, the markets are now resting at intermediate levels. It remains to be seen whether these prices will hold or whether, during what is normally a quiet period, they will ease and eventually take another downward plunge into unprofitable regions for producers. It is difficult to judge, but certainly strong reactionary movements in a market tend invariably to over-reach themselves.

MR. I. A. R. STEDEFORD, chairman and managing director of Tube Investments, Limited, left Britain by air for India on Sunday. During his stay he will visit Delhi, Bombay, and Madras, and will confer with Indian industrialists and merchants on plans of mutual interest. He will be accompanied by MR. ARTHUR CHAMBERLAIN, a director of Tube Investments.

S. WOLF & COMPANY, LIMITED, Pioneer Works, Hanger Lane, Ealing, London, W.5, has designed and placed on the market a portable electric hammer for wall boring. It weighs 7 lb. and is powered by an ¼-h.p. motor. It penetrates concrete when making a $\frac{7}{32}$-in. dia. hole at a rate of 1⅛ in. per min., and under similar conditions penetrates 5 in. into brickwork.